

PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA



PLANTERS' BULLETIN FIFTY-SIX

SPECIAL PLANTERS' CONFERENCE ISSUE

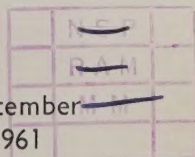
CONTENTS

	Page
Editorial: Planters' Conference 1961	115
PAPERS AND DISCUSSIONS ON TAPPING AND YIELD STIMULATION	
Survey of Commercial Yields in Relation to Tapping Systems	117
Tapping Systems and Yield Stimulation on Three Estates	139
Tapping of Young Rubber	149
OPEN DISCUSSIONS	
Weed Control and Herbicides	160
Cover Plants, Manuring and Wind Damage	163
Root Disease Control	167

Price
50 Cents



September
1961



R R I

LOCATION. The Institute's laboratories and offices at the third mile, Ampang Road, Kuala Lumpur are open from 8 am to 1 pm and 2 pm to 4 pm on Mondays to Fridays, and from 8 am to 12.30 pm on Saturdays.

EXPERIMENT STATION AND FACTORY. This station of the R R I is situated 16 miles from Kuala Lumpur, at Sungei Buloh on the Kuala Lumpur — Kepong — Kuala Selangor road. Visits may be made on Mondays or Wednesdays by arrangement. There is a guest house.

CORRESPONDENCE. All LETTERS must be addressed to the Director, Rubber Research Institute of Malaya, Post Office Box 150, Kuala Lumpur. Special enquiries may be marked for the attention of particular officers. The address for TELEGRAMS is Searching, Kuala Lumpur. TELEPHONE: Kuala Lumpur 72051. PARCELS occasionally arrive without any indication of their origin. Senders' names and addresses should be written clearly on the outside of all packages, and advice of despatch should be given by letter or telegram.

PROHIBITED PLANT SPECIMENS. Attention of planters and others in territories outside the Federation of Malaya and Singapore is drawn to the Malayan Plant Importation Rules which prohibit the importation into Malaya of any part of a plant, whether living or dead, unless it is accompanied by a permit issued by the Director of Agriculture, Federation of Malaya. No permit will be issued in respect of any diseased plant or any plant pest. Any plant imported in contravention of these Rules (whose object is to prevent the introduction of diseases or pests) will be destroyed without examination. Anyone outside Malaya who desires our advice on any matter that may require examination of living material must first enquire by letter.

ADVICE. Enquiries are invited from rubber producers in the Federation of Malaya, Singapore, Nigeria, the colony of North Borneo, and the territories of Sarawak and Brunei, who may require more detailed information applicable to their own special problems. Where it is considered necessary, visits will be made to estates in Malaya as convenient. Visits to estates in other territories are by special arrangement. The only visits for which charges are normally made are those of our clone identification inspectors. INTERVIEWS should be arranged by letter, as members of the senior research and advisory staff are frequently absent on visits to plantations.

PUBLICATIONS. Subscription to all or any of our series of publications (*Planters' Bulletin*, *Journal*, *Reports*, and miscellaneous booklets) may be made by depositing \$15 with us. An annual statement of account will then be submitted. We are unable to give annual subscription rates or any form of discount, but for multiple subscriptions a lower rate of initial deposit is acceptable. Postage is charged on overseas mailings. A list of 'Publications of the R R I' is available on request.

PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur

September 1961

Number 56

Editorial: Planters' Conference 1961

For the second time this year, *Planters' Bulletin* deviates from its normal policy of issuing 'firm recommendations based on the results of research', this time to publish a full account of the Planters' Conference held at the Institute on July 28th and 29th. We therefore have to emphasise that the papers and discussions reported here do not necessarily represent the views of the R.R.I.M.; in fact, many of the statements made are at variance with our standard recommendations.

In order to present a concise and unrepetitive account of the discussions, we have had to abridge the verbatim records of the proceedings. We have nevertheless adhered as far as possible to the actual order of speaking, and in this way we hope to retain some of the original 'conference flavour' in our report. Thus the discussion of a single subject is not always continuous. There are also some deviations from the main topics at hand; for example the discussion on 'Weed Control and Herbicides' became concentrated on the choice of cover plants, perhaps because the distinction between 'near weeds' and cover plants is still not entirely clear-cut.

Although it would be impossible, within the brief space available, to summarise the proceedings of the Conference as a whole, we feel that it will help readers to record here some of our main impressions. They will find that the discussions of the three formal papers on 'Tapping and Yield Stimulation' are an adequate reflection of the intense interest shown in these subjects. It became clear during these discussions that there is a need for a more intensive enquiry into the profitability of various tapping systems, and indeed of all management systems. The standards of comparison most frequently mentioned at the meeting, were 'yield per acre' and 'yield per tapper', but the problem of how to strike the correct balance between these two measures of output remains to be solved.

Mr Shearlaw showed that good yields per tapper were obtained by systems of 67% intensity. He also demonstrated the higher yields obtainable by the double-cut third daily periodic system (2C/2.d/3.12m/16.100%) compared with single-cut tapping of the same intensity. His figures suggest that continued single-cut tapping at 67% is too light an intensity for mature buddings. The same speaker compared the yields of clonal seedlings and mixed buddings, to a large extent in favour of the former, but as the survey covered only a limited range of clonal material it would be instructive to compare Mr Shearlaw's results with records derived from modern high yielding clones which are comparable in yield with RRIM 501.

Mr Chen Jan Jee's paper contained novel and indeed for many planters revolutionary statements. His records of task size (larger than usual) and of girth at opening (smaller than usual) are of special interest. The debate on these topics is likely to continue and, as in the case of assessing the profitability of tapping systems, there is an evident need for professional economists to investigate the consequences of variations in task size.

Mr de Jonge, in his paper on 'Tapping of Young Rubber', concentrated on the effect of tapping on girdling. A reduction of tapping intensity by reducing the frequency from S/2.d/2.100% to S/2.d/3.67% caused a 20% loss of crop but did not lead to improved rate of girdling. He supported the hypothesis that reducing tapping intensity in another way — by introducing periodic resting periods — would lead to improved girdling and so might provide a partial solution to the problem of alleviating wind damage. On the subject of yield stimulation, he stated that the systems recommended at present were not too intensive, and quoted a recent experiment showing that stimulants could be applied at three-monthly instead of six-monthly intervals without inducing undesirable effects in the trees.

Among the topics raised in the Open Discussions, the problem of wind damage is still very much in the planter's mind. An important point made was the need for care in manuring wind susceptible trees. It was suggested that on fertile soils manuring of leguminous covers may be reduced at the time when they are shaded out, since the covers themselves return large quantities of nitrogen and other elements to the soil. In connection with wind damage and indeed with many other problems, planters were asked to help the R.R.I.M. by supplying information. Usually, only 60–70% of our questionnaires are returned and occasionally the response falls well below that level. We look forward to the day of the 100% return.

In the discussions on the control of weeds and root disease, points of R.R.I.M. policy and progress were given prominence. Work continues at the Institute on the task of finding alternatives to sodium arsenite; many new chemicals show promise as herbicides, but all are comparatively expensive. The nature of the changes in the Institute's advice on root disease control was explained. It was made clear that there is a possibility of eliminating the major root diseases now that improved methods of treatment are known and the importance of preventing the colonisation of moribund stumps by fungal spores is realised.

In recording these impressions of the Conference we are of course only skimming the surface of what may well be regarded as very deep waters. To obtain a correct impression of the value of the meeting, it is necessary to read the report as a whole, and with a very critical eye. We hope that this report will be useful to planters, both as a source of information and as a basis for private discussion; not least, we hope it will inspire them to start now on the evaluation of estate records which may eventually provide material for the technical papers on which the success of future conferences will depend.

Survey of Commercial Yields in Relation to Tapping Systems

Paper presented by P.W. Shearlaw, Harrisons & Crosfield (Federation of Malaya) Ltd

This study is a natural sequence to a similar survey done in late 1959 covering the years 1956 to 1959, the results of which were circulated privately. Those results, extracted for a specific purpose, covered only part of the Harrisons & Crosfield Agency: the present survey is more fully representative than the earlier one in that it has been extended to cover all estates in the Agency which can supply data appropriate to the enquiry.

From January 1960, figures of yield per acre and per tapper for *all* estates have been supplied to the Prang Besar scientists and, for these, averages for the various classes of planting material have been worked out on a per acre and per tapper basis.

At the Natural Rubber Research Conference (1960), the writer voiced the opinion that, in the past, research had been too much concentrated on yield per acre. So far as is known, the economic aspects of *yield per tapper* have not been studied, although these are just as important as yield per acre to the practical planter. In estate accounts, tapping cost is by far the largest single item, and is the factor which the manager can most easily control — by variation of tapping systems. This survey, therefore, devotes equal attention to yield per acre and yield per tapper.

Throughout this survey, data on 'PB 86' are from mono-clone blocks; 'Mixed Clones' includes a fair proportion of PB 86, but estate records are so numerous that condensation of records is necessary to minimise work and no separate records for the various clones are kept. The main constituents of Mixed Clones in the 1956/59 Survey were PB 86, 186 and 25, Tjir 1 and Pil B84. For the 1960 Survey, details of clones are given in *Appendix I*, including the number of recordings in which each clone appears.

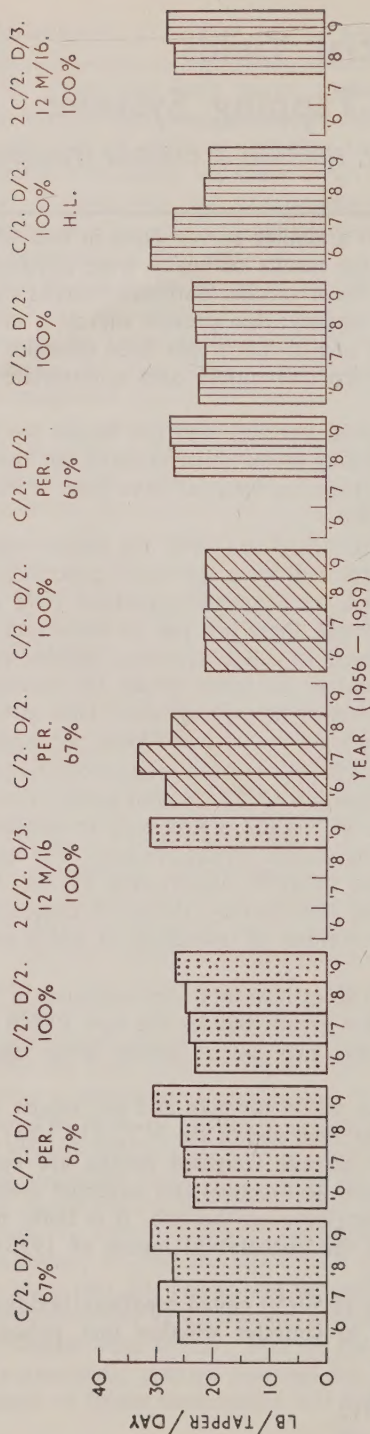
Generally, blocks of less than 20 acres have not been included in the survey (the danger of error being too great), but for the new PBIGG 1 smaller blocks have been used, only two out of fifteen being under 12 acres.

In the 1956/59 Survey, the mean yields per acre and per tapper are arithmetical means; in the survey for 1960 and of the 2C/2.d/3.12m/16.100% system, the more accurate acreage weighted means are used. 1960 figures were worked out as both arithmetical and weighted means, and generally there is little difference between the two. It is fairly reasonable to assume, therefore, that the arithmetical means of 1956/59 result in few, if any, major errors.

On many estates, planting policy is 50/50 clonal seedlings/buddings, and the object of this survey is to consider whether that policy is justified by results.

PBIGS
PB 86
MIXED CLONES

PER. = PERIODIC
H.L. = HIGH LEVEL



Year	Yield (Hundred LB / Acre / Annum)
'66	~8.5
'67	~8.8
'68	~9.0
'69	~9.2
'70	~9.5
'71	~9.8
'72	~10.0
'73	~10.2
'74	~10.5
'75	~10.8
'76	~11.0
'77	~11.2
'78	~11.5
'79	~11.8
'80	~12.0
'81	~12.2
'82	~12.5
'83	~12.8
'84	~13.0
'85	~13.2
'86	~13.5
'87	~13.8
'88	~14.0
'89	~14.2

Year	15-19 (%)	20-24 (%)
1956	12	18
1957	13	19
1958	13.5	20
1959	14	22

FIGURES 1A AND 1B. 1956 — 1959 SURVEY. YIELDS AT VARIOUS TAPPING INTENSITIES (1936 — 1941 RUBBER)

THE 1956 — 1959 SURVEY

The primary objective of the original survey was to ascertain yields (per acre and per tapper) from large areas of PBIGS. The estates chosen for this survey were, therefore, those with substantial areas under that material, and the only comparison was with yields from buddings on those estates. The subsequent extension of the survey to include all estates broadened the basis of comparison.

1936/41 Rubber

Figures 1A and B give the available records of yields over the four years, per tapper and per acre respectively, for various tapping systems. Where tapping is continuous, the average monthly yield is multiplied by 12, where 67% periodic, by 8, and where 12m/16, by 9, to arrive at the yield per 'field' acre per annum.

Yield per acre. In per acre yield, the outstanding feature is the low figure for PBIGS on 67% periodic (compare with C/2.d/3.67%). PB 86 did very poorly on 67% periodic, while the Mixed Clones on that system did much better than either PBIGS or PB 86. On C/2.d/2.100%, there is little difference between yields of PBIGS and PB 86, both being slightly better than Mixed Clones on the same system. Mixed Clones on 100% high level (HL) gave yields comparable to PBIGS and PB 86 on 100% basal tapping, and HL yield was not greatly better than 100% basal. PBIGS on 2C/2.d/3.12m/16.100%, with only one year's yield available, is comparable only with the same material on 100% basal. In the first of two years' tapping, Mixed Clones on 2C/2.d/3.12m/16.100% gave about the same yield as PBIGS on the same system, but in the second year the yield of the Mixed Clones, with more recordings and a larger acreage, shows a sharp increase.

Yield per tapper. The best yield per tapper comes from PBIGS and PB 86 on certain tapping systems, the former on C/2.d/3.67%, the latter on 67% periodic. The yield per tapper for PBIGS is better on C/2.d/3.67% than 67% periodic (as for yield per acre) and lower on C/2.d/2.100% than on either of the 67% systems; the yield from the one year on double-cut periodic is comparable with the best of the PBIGS yields on other systems. There is a heavy drop in PB 86 yield between 67% periodic and C/2.d/2.100%. Per tapper yield for Mixed Clones on 67% periodic is comparable with the figures for PBIGS and PB 86 on the same system. Mixed Clones on 100% basal are below the same material on 67% periodic, and below PBIGS on any of the systems shown. Per tapper yield from Mixed Clones on 100% HL falls off steadily over the years, possibly a result of position of cuts in the majority of cases. The yield per tapper for Mixed Clones on 2C/2.d/3.12m/16.100% is higher than on 100% basal, and about the same as on 67% periodic.

PBIGS
 PBFPs
 COMMERCIAL YIELDS REPORTED IN PLANTERS' BULLETIN 36, 1958



PB 86
 MIXED CLONES

FIGURE 2A

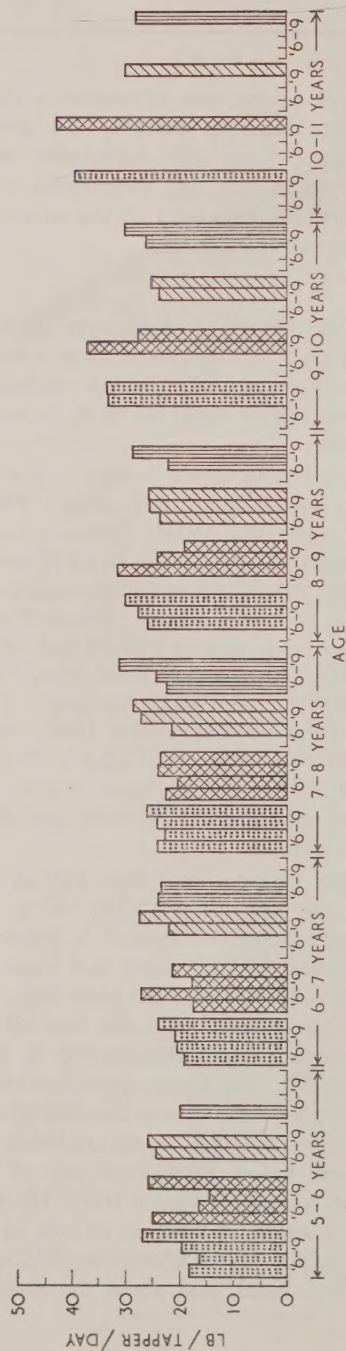
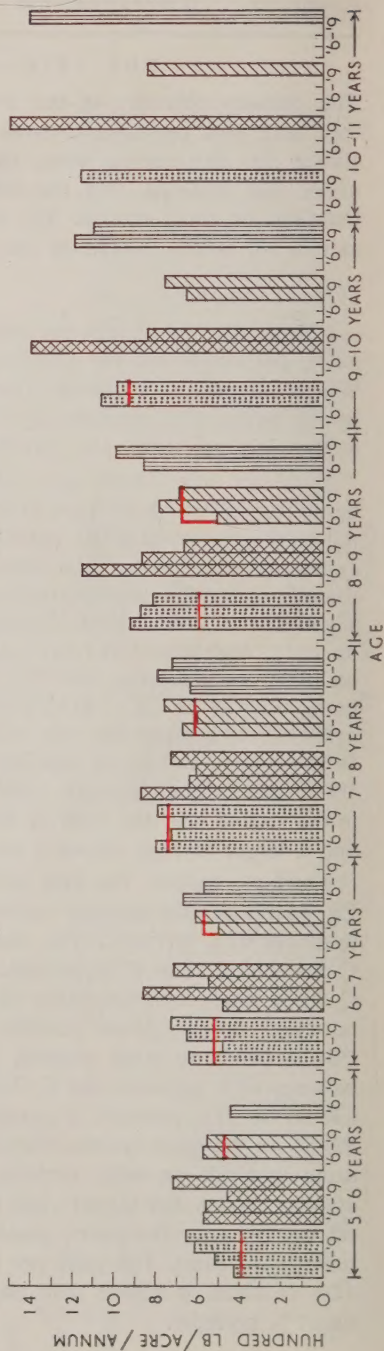


FIGURE 2B



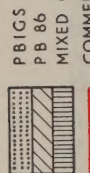


FIGURE 3A

COMMERCIAL YIELDS REPORTED IN PLANTERS' BULLETIN 36, 1958

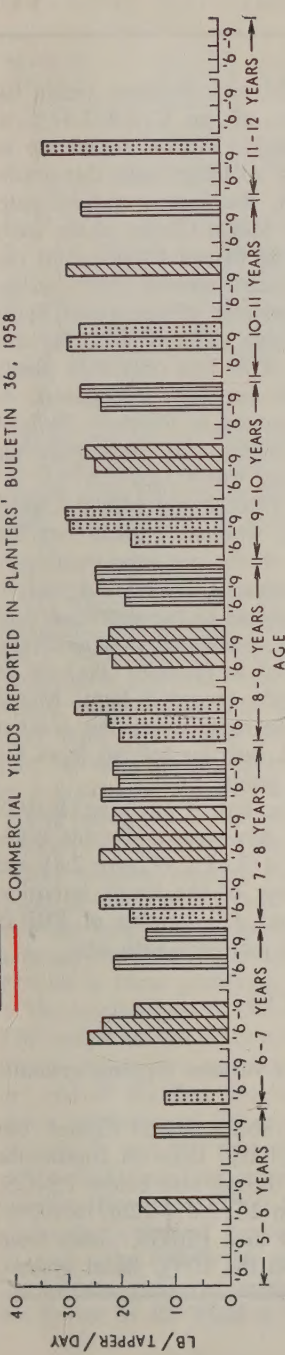
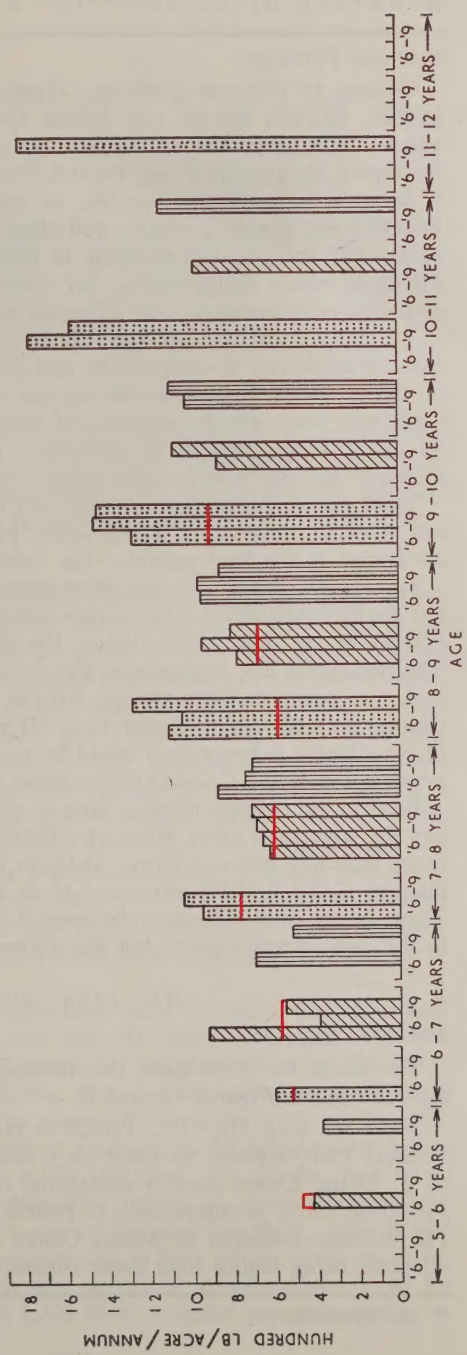


FIGURE 3B



FIGURES 3A AND 3B. 1956 - 1959 SURVEY. POST - WAR RUBBER TAPPED C/2. D/2. 100 %

A Survey of Commercial Yields

Post-war Plantings

Coming to post-war plantings, *Figures 2A and B* show yields for PBIGS, PBFPS, PB 86 and Mixed Clones, all on C/2.d/3.67% at various ages, over the four years. Surprisingly, PBFPS shows up as the leader, though the Prang Besar Company no longer sells this grade, it being considered too variable, as indeed, the histograms indicate. PBIGS holds a good position, well ahead of Mixed Clones in the early years, with the position changing in favour of Mixed Clones later on. PB 86 is rather disappointing; for several years around 1950 'hedge' plantings were common, and although any adverse effects would apply to all materials of that vintage, PB 86 probably suffered most, for this clone is intolerant of competition, and gives of its best only with plenty of living space. Superimposed on the yield per acre histograms, as horizontal lines, are the commercial yields quoted in *Planters' Bulletin 36* (May 1958). PBIGS in particular, compares very well with the *Planters' Bulletin* figures, even though tapping was C/2.d/3.67%.

Yield per tapper figures (*Figure 2A*) for PBIGS and Mixed Clones are roughly comparable in the early years, whereas PBIGS has the advantage in the later period — the reverse of the per acre trend.

Figures 3A and B give the same comparisons as *Figures 2A and B*, but for C/2.d/2.100%. There is no doubt here as to the ascendancy of PBIGS in per acre yield. Again, PB 86 is considered disappointing. The horizontal line representing figures quoted in *Planters' Bulletin 36* makes a poor showing against PBIGS yields recorded here. Mixed Clones are only slightly better than PB 86. In some cases, the number of recordings* is lower than could be wished, but this follows from the popular use of the C/2.d/3.67% system for young rubber.

In yield per tapper, there is little to choose, but, if anything, PBIGS has the edge over other materials. There is, however, a sizeable difference generally between tapper yield on C/2.d/3.67% (*Figure 2A*) and that on C/2.d/2.100% (*Figure 3A*) in favour of the lower intensity. There is no great difference between d/2 and d/3 tapping of PBIGS in the early tapping years, but the difference increases with age.

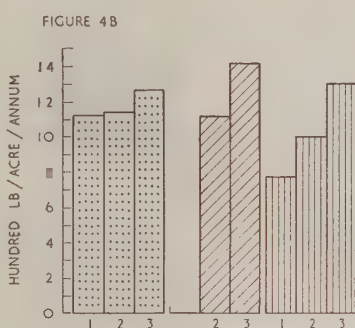
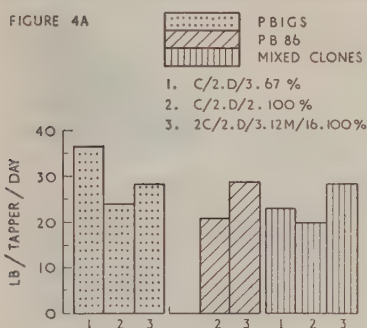
THE 1960 SURVEY

1936/41 Rubber

The yields for 1960 from this rubber, on various tapping systems, are recorded in *Figures 4A and B*.

Yield per acre. On 67%, PBIGS is much above Mixed Clones, but whereas PBIGS yields no more on C/2.d/2.100% than on continuous 67%, Mixed Clones show a substantial rise though still below PBIGS. PB 86 on 100% is comparable to PBIGS. On 2C/2.d/3.12m/16.100%. PB 86 leads, followed by Mixed Clones and then PBIGS, yields from all three being higher than those obtained on the 100% basal system.

* see Appendix I



FIGURES 4A AND 4B. 1960 YIELDS. YIELDS AT VARIOUS INTENSITIES (1936-1941 RUBBER)

Yield per tapper. PBIGS shows an excellent yield per tapper on 67%, far above Mixed Clones. On C/2.d/2.100% PBIGS still leads, with PB 86 and Mixed Clones still behind. On the double-cut, periodic 100% system, there is nothing to choose between the three materials.

Post-war Rubber

C/2.d/3.67% Yields for post-war plantings on this tapping system are given in *Figures 5A and B*. On per acre yield, PBFPS leads (as in the 1956/59 Survey), closely followed by PBIGS; PB 86 of 1948/50 plantings is poor, but the plantings of 1951 onwards are much better. Mixed Clones are erratic and in only one year — 1950 Planting — does their yield exceed that of PBIGS. Tjir 1 selfed seeds are roughly one year behind PBIGS. Figures from *Planters' Bulletin 36* are again shown by a horizontal line and confirm the findings of the 1956/59 Survey.

The histogram on the extreme right of *Figure 5* records the new seed, PBIGG 1, planted in 1955; the yield is *not* for 1960, but for the first twelve months' tapping on the fifteen recordings, covering 360 acres. Yield is much better than for any other seedling grade, being midway between seven- and eight-year old Tjir 1 selfed, and nearly midway between six- and seven-year old PBIGS. The mean yield per tapper of 22.4 lb is most gratifying.

The implications of this excellent early yield are not to be overlooked. The oldest of the PBIGG 1 plots was six years (yielding 836 lb per acre in the twelve months), the youngest five years (yielding 634 lb) at the end of the first year's tapping. No opening was done until there was a minimum of 100 trees per acre of 22 in. girth at 20 in. from the ground. It was felt that opening at four years old might affect future yields, but that fear appears to be dispelled, for in the first seven months (November 1960 to May 1961, which of course includes the wintering period) of the second year of tapping this block, yield is 667 lb, with over 100 lb per acre per month in four of the seven months: the highest yield per tapper in this period of seven months is 46 lb, the lowest 31 lb. Yield is thus 1,301 lb in nineteen months' tapping of

FIGURE 5A

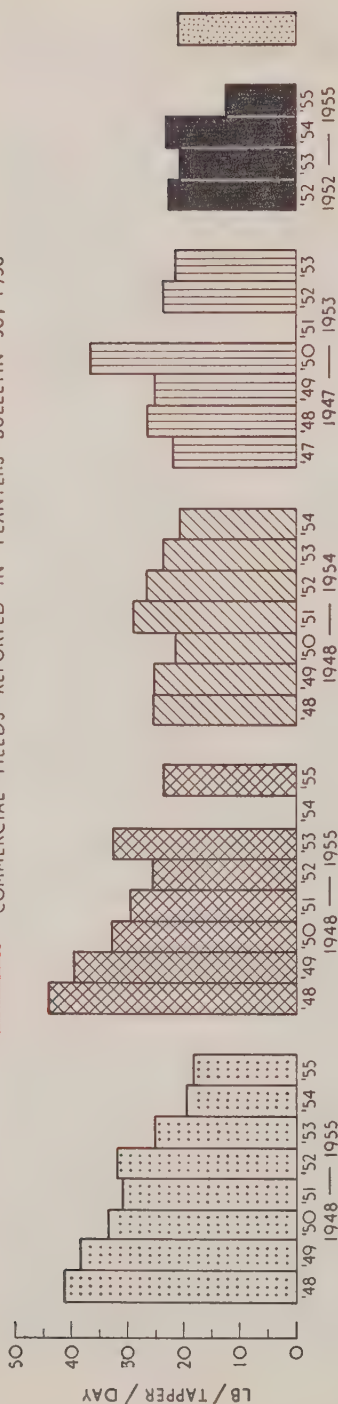
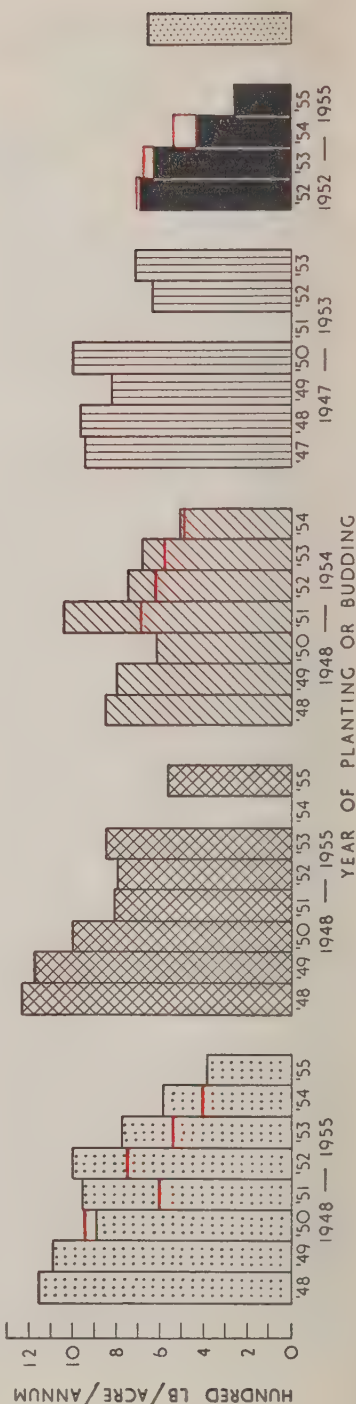


FIGURE 5B



FIGURES 5A AND 5B. 1960 YIELDS. POST-WAR RUBBER TAPPED C/2. D/3. 67%

rubber opened at four years, while that for twenty-one months in rubber opened at four years and four months is 1,323 lb. Yet another area, opened at four years one month, has given 986 lb in seventeen months.

It seems a fair assumption, therefore, that PBIGG 1 opened on girth qualification will, on average, have yielded at least 1,000 lb per acre before buddings (seedling stocks for which were planted at the same time as the clonal seeds) come into bearing. Taking this figure of 1,000 lb as the advantage to clonal seeds at May 1961, anticipated crops would be:

	PBIGG 1, lb	Buddings, lb	Advantage to PBIGG 1, lb
At end May 1961	—	—	1,000
Yield June 1961 to May 1962 ...	1,200	800	1,400
„ „ 1962 to May 1963 ...	1,400	1,000	1,800
„ „ 1963 to May 1964 ...	1,600	1,200	2,200
„ „ 1964 to May 1965 ...	1,600	1,400	2,400
„ „ 1965 to May 1966 ...	1,600	1,600	2,400

At May 1966, both materials are envisaged as having reached their peak. It may be held that 1,600 lb is too low a peak for buddings, and that these will, in later life, give higher yields than clonal seeds. This, however, is open to doubt, and there is nothing in the histograms to support that belief. Also, out of the many thousands of new clones made since the introduction of budding (the Rubber Research Institute of Malaya made at least 1,700 clones to produce the 600 series alone and Prang Besar now make some 300 to 400 new clones a year), few indeed have stood the test of time. Apart from the primary clones Tjir 1 and PB 86, what clone is there today that can be confidently recommended for large scale planting, except, possibly PB 5/51 and RRIM 605? There seems no reason to anticipate that, out of future clones, a greater percentage than in the past will survive the proof stages. If a plant breeder can produce, during his lifetime, *one* clone that combines high yield, good bark renewal, reasonable freedom from brown bast and wind resistance, he will do well. With due regard to habit as well as high yield, seed gardens may be budded with several clones which have proved to be good seed-parents in previous combinations, and have similar flowering periods, and these gardens are ultimately thinned to include three to seven clones after additional data become available from hand pollination and polycross trials. In this connection, the PBIGG 1 yields above are from a garden which, in 1955, contained seventeen clones, since thinned to seven: the PBIGG 1 seed now supplied, therefore, should be considerably more high yielding than the material supplied in 1955.

Returning to *Figure 5A*, per tapper yield closely follows the per acre trend, with PBIGG 1 tapper yield rather better than that of PBIGS



 PBIGS
 PB 86
 MIXED CLONES
 RRIM 501
 COMMERCIAL YIELDS REPORTED IN PLANTERS' BULLETIN 36, 1958

FIGURE 6A

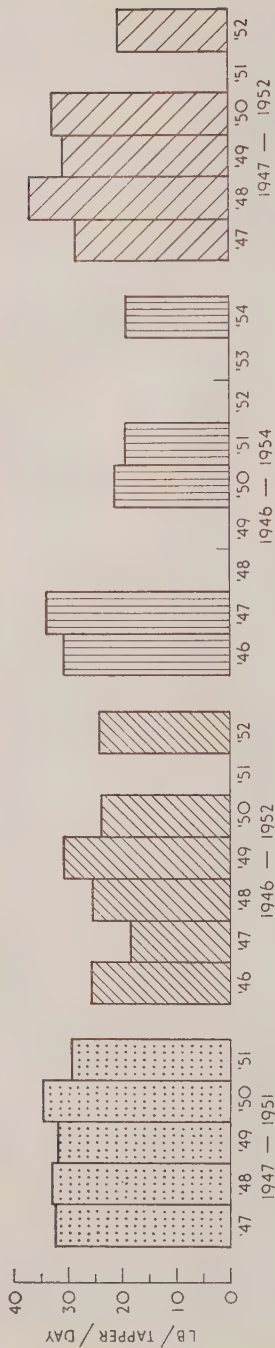
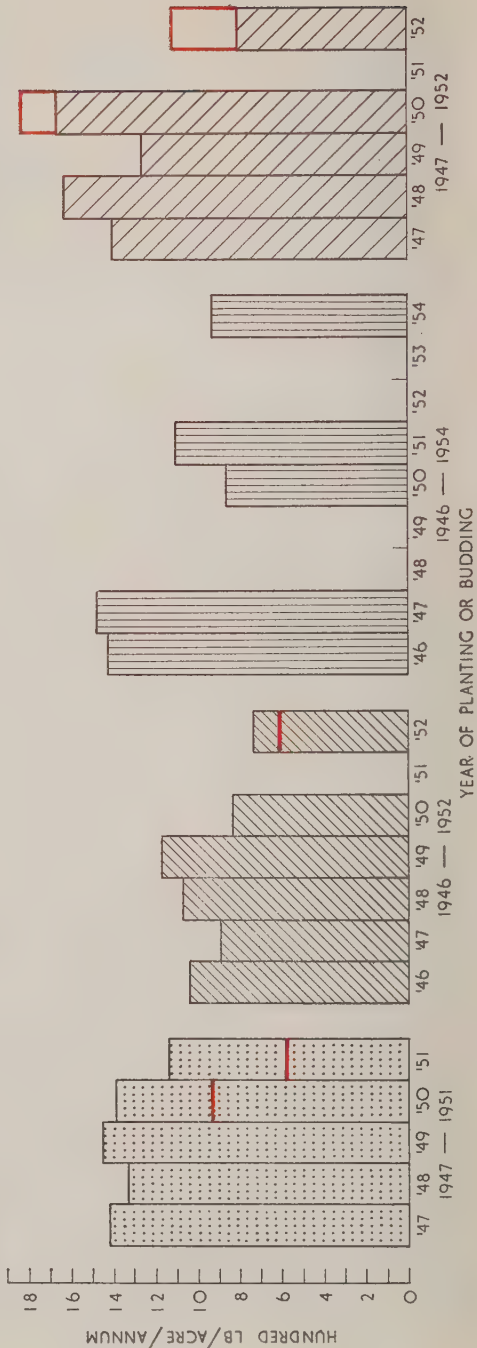


FIGURE 6B



FIGURES 6A AND 6B. 1960 YIELDS. POST - WAR RUBBER TAPPED C/2. D/2. 100 %

planted a year earlier.

C/2.d/2.100%. Yields for PBIGS, PB 86, RRIM 501 and Mixed Clones for 1960 on this tapping system are given in *Figures 6A and B*. RRIM 501 is an easy leader, and it is a great pity that such a high yielding clone has had to be discarded, for the time being at least. Apart from RRIM 501, PBIGS makes an excellent showing, and compares well with either PB 86 or Mixed Clones. The number of recordings is generally low, a result, as already noted, of wide use of 67% tapping in young rubber. Per tapper yields do not diverge widely from the per acre trend.

1936/41 Rubber. 2C/2.d/3.12m/16.100% System

Records from this tapping system are shown in *Figures 7A and B*. 'Control year' is the Company's financial year prior to the introduction of the double-cut system. A 'period' is not of a uniform number of months, the records having been taken at irregular intervals, mainly as and when the author found the time necessary to go into the matter. Generally, a *minimum* period of six months has been used, but in many cases the period represents a full year. The longest tapping on this system lasted thirty-eight months, applicable to Mixed Clones tapped, during the control year, at 67% periodic.

Taking the control year as 100%, the results of this double-cut system are indicated as a percentage on each histogram. The two additional histograms (S and D), alongside those where the control year was C/2.d/2.100%, show the relative figures for the calendar year 1960; they are taken from *Figures 4A and B* and are repeated here for ease of comparison.

The main feature of the histograms is the very large increase in yield per acre where the double-cut system followed 67% tapping: it may be reasonably assumed that, for rubber of the age group considered, 67% was definitely undertapping. Increases following 100% tapping in the control year are lower, but still very satisfactory in most cases. The *only* material and period which shows lower yield on double-cut 100% than on normal C/2.d/2.100% is PBIGS in the first period. In this case, two of the thirteen recordings are from the same estate, and as both are from large fields, which show a *fall* of nearly 20% in yield per acre and of 30% in yield per tapper compared with the control year, some suspicion must attach to these two recordings. (If these two recordings are excluded, the percentage figures would be 100% for yield per acre, 104% for yield per tapper). As both recordings gave over 1,600 lb in the control year, it was possibly a mistake to change such rubber to double-cut tapping, especially as bark reserves on basal panels were very good. The results of these two recordings appear to lend support to de Jonge's* view that double-cut tapping gives the

* P. de Jonge. Intensive tapping of mature rubber, *Proceedings of the Natural Rubber Research Conference 1960* (Published 1961 by the R.R.I.M.)

SINGLE-CUT SYSTEMS AS INDICATED

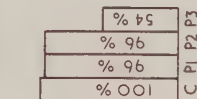
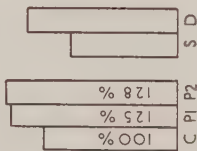
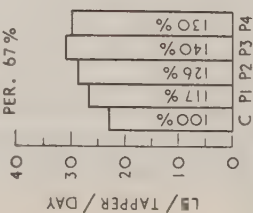
C — CONTROL YEAR
P1 — FIRST PERIOD
P2 — SECOND PERIOD
P3 — THIRD PERIOD
P4 — FOURTH PERIOD

2C/2.D/3. 12M/16. 100%

FIGURE 7A

MIXED CLONES.
CONTROL
C/2.D/2.
PER. 67%
H.L.

MIXED BUDDINGS/
SEEDLINGS.
CONTROL
C/2.D/2.
PER. 67%



S — SINGLE-CUT C/2.D/2. 100%
D — DOUBLE-CUT 2C/2.D/3. 12M/16. 100%
PER. - PERIODIC
H.L. — HIGH LEVEL

PBIGS.
CONTROL
C/2.D/2.
PER. 67%
100%

PBIGS.
CONTROL
C/2.D/3.
67%
(STIMULATED)

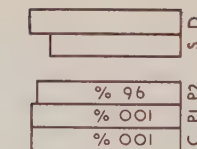
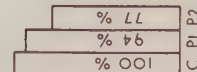
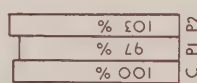
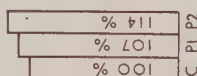
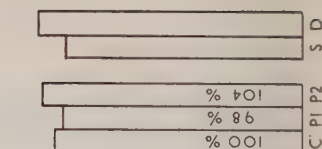
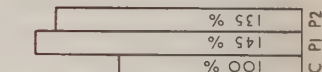
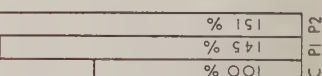
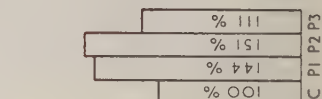
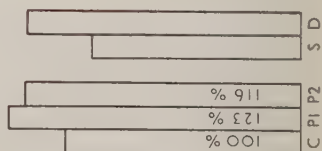
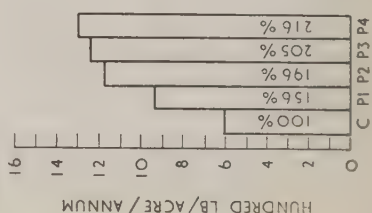


FIGURE 7B



FIGURES 7A AND 7B. COMPARISON OF YIELDS FROM 2C/2.D/3. 12M/16. 100% WITH YIELDS FROM PREVIOUS SYSTEMS (1936 - 1941 RUBBER)

best results when high virgin bark above poor or poorish lower panel renewal is tapped as part of the double-cut system.

There are fewer recordings for PBIGS than for buddings and for this there are two reasons: (i) a feeling (now proved to be erroneous) in the early days of double-cut tapping that the more tapering clonal seedlings (compared with the more cylindrical stem of buddings) would result in lower crops from high panels of the seedlings; (ii) the fact that high tapping became necessary earlier in life in buddings than in clonal seedlings—note from *Figures 1A and B and 7A and B* that, while buddings have been tapped at high level, no PBIGS have had to be so tapped. (A corollary, supported by the author's experience, is that bark renewal on clonal seeds is, in general, superior to that on buddings). It will be seen that in *Figure 7*, as in previous illustrations PBIGS compares favourably with Mixed Clones.

Judging by the histograms covering the longest period, the resting period appears to have brought about a progressive advantage in yield.

The per tapper yield illustrations generally follow those of yield per acre.

FURTHER IMPLICATIONS OF EARLY MATURITY

In all considerations of the economics of rubber, the imponderable is the commodity price, and for the present purpose, this is ignored.

As already noted, PBIGG 1 has given substantial yields before field buddings (the stocks for which were planted at the same time as the clonal seeds) have reached the tappable stage. That, however, is not the end of the story to the planting economist.

Assuming a rate of interest of 7%, today's equivalents of one dollar to be received in 1, 5, 10, 20 and 30 years hence are 93.5, 71.3, 50.9, 25.8 and 13.1 cents, respectively.

Similarly, 93.5, 71.3, 50.8, 25.8 and 13.1 lb are today's value of 100 lb of rubber to be harvested 1, 5, 10, 20 and 30 years hence respectively. It follows therefore, that the value of crops from early maturing rubber is greater than the same crop from slower maturing material. In the case of PBIGG 1 and buddings for which crop estimates have been given, and assuming a difference of only one year in the immature period, each 93.5 lb of crop from PBIGG 1 is equal in value to 100 lb of crop from buddings, in the first year of tapping of each. Continuing on the same basis, it also follows that, at the end of May 1966, the advantage in yield to PBIGG 1 will be considerably *more* than the 2,400 lb shown.

Taking the figures used earlier for May 1956 to June 1966, of 1,600 lb per acre for both materials, this yield from PBIGG 1 is then equal to $\frac{100 \times 1600}{93.5} = 1711$ lb from the buddings, which, on the same peak yield as clonal seedlings, must obviously fall further into arrears year after year. *Unless*, therefore, PBIGG 1 fails to live up to its early promise or a clone (or clones) is found which can give 1711 lb per acre

A Survey of Commercial Yields

per annum, plus enough to overtake the arrears in the lifetime of the tree, it would appear that these clonal seedlings may be better profit makers than buddings. Further, any arrears of buddings above 1600 lb in the June 1965 — May 1966 year would be subject to *two* years deferment, i.e. each such 100 lb from buddings is worth only 87.3 lb from clonal seedlings.

There is one more factor involved: the extra year's upkeep cost in the case of buddings, which is put at \$80 per acre. The buddings, therefore, have to pay interest on an investment of \$80 per acre more than clonal seedlings; this also at the deferred values shown.

This aspect of the choice of planting materials is one which, so far as the author is aware, has never been touched on in research, but it is certainly not to be ignored by any planter who is seeking the maximum economic return.

The views given above are of course those of the author alone and are expressed here purely as a personal contribution to the Conference.

ACKNOWLEDGEMENTS

The author's thanks are due to Messrs Harrisons & Crosfield for permission to publish the figures used in this survey, to Messrs B.S. Gray, R. Shepherd and J. William for their work in connection with the collection and collation of records and to Mr P. de Jonge of the R.R.I.M., who has worked in close co-operation on the double-cut tapping system, and with whom the author has had many valuable and fruitful discussions.

APPENDIX I. DETAILS OF MIXED CLONES, 1960 SURVEY

Numbers of recordings for each clone in parenthesis

1936/41 Rubber

Tapped C/2.d/2.100%:

Tjir 1 (17),	PB 86 (14),	Pil B84 (11),	PB 25 (10),
PB 186 (5),	Tjir 16 (2),	Lun N (2),	Pil D65 (1),
RRIM 501 (1),	RRIM 504 (1),	RRIM 505 (1),	RRIM 511 (1),
RRIM 512 (1),	AVROS 49 (1),	'PB Clones' (1),	Cluny 75 (1).

Tapped C/2.d/3.67%:

Tjir 1 (1), PB 186 (1), PB 86 (1), Pil B84 (1), BD 5 (1).

Tapped 2C/2.d/3.12m/16.100%:

PB 86 (12),	PB 25 (9),	Tjir 1 (7),	PB 186 (5),
Pil B84 (3),	Cluny 75 (2),	Lun N (1),	PB 49 (1),
PB 180 (1),	PB 123 (1),	PBFP Clones (1),	PBPP Clones (1),
Waring (1),	Sab 24 (1),	Bikam (1).	

Post-war Rubber

Tapped C/2.d/3.67%:

Tjir 1 (1), PB 86 (1), PB 186 (1), Pil B84 (1), BD 5 (1).

Tapped C/2.d/2.100%:

PB 86 (5),	RRIM 600 Series (3),	Tjir 1 (2),
RRIM 501 (2),	RRIM 511 (2),	PR 107 (2),
PB 5/51 (2),	PB 5/60 (1),	PB 5/37 (1),
PB 180 (1),	PB 49 (1),	PB 25 (1),
PB 32/36 (1),	PBPP Clones (1),	RRIM 500 (1),
		RRIM 511 (1).

APPENDIX II. TABLE OF RECORDINGS AND ACREAGES

Figure	PBIGS		PBFPs		PBIGG I		Tjir I Selfed		PB 86		RRIM 501		Mixed buddings		Total	
	No. of recordings	Acreage	No. of recordings	Acreage	No. of recordings	Acreage	No. of recordings	Acreage	No. of recordings	Acreage	No. of recordings	Acreage	No. of recordings	Acreage	No. of recordings	Acreage
1	457	26,292	-	-	-	-	-	-	49	1723	-	-	316	16,012	822	44,026
2	399	26,913	58	2600	-	-	-	-	41	2944	-	-	39	2321	537	34,778
3	61	3900	-	-	-	-	-	-	128	8054	-	-	72	3169	261	15,124
4	95	5490	-	-	-	-	-	-	13	544	-	-	58	2414	166	8447
5	133	9,854	26	1142	15	360	17	1240	27	1774	-	-	16	702	234	15,072
6	25	1834	-	-	-	-	-	-	34	2186	9	383	16	547	84	4950
7	79	4422	-	-	-	-	-	-	-	-	-	-	104	7657	183	12,079
Total	1249	78,705	84	3742	15	360	17	1240	292	17,225	9	383	621	32,822	2287	134,476

DISCUSSION

*Chairman: Mr C.W. Brookson, Head of the Botanical Division,
R.R.I.M.*

MR BOON WENG SIEW (Malaka Pinda Estate, Alor Gajah, Malacca). In the case of 67% third daily tapping, we have an increase of yield per tapper per day, but a decrease of yield per acre per annum. Now let us say that under the d/2.100% system the overhead charges will be 16 cents per lb. If we bring these trees into the 67% system of tapping, would you not say that the yield per acre would be reduced by 20%, and would it not follow that the allocation of general charges to the cost of production would be increased by 4 cents per lb? Is the reduction in the cost of tapping enough to compensate for this increase of 4 cents per pound?

MR SHEARLAW. From the 1960 yield figures which you saw, I extracted the relationship between crop per acre and crop per tapper for d/3.67% and d/2.100% tapping; d/3 gave only 82.6% of the crop obtained from d/2, but the yield per tapper was 120% of the yield from d/2. My conclusions are that the cost of production on third daily tapping is almost exactly the same as on alternate daily tapping. The general charges mentioned by the questioner can be reduced when the tapping intensity is decreased. On third daily tapping you require only two-thirds of the number of tappers, you save on hospital and medical services, you save on maternity benefits, on holiday pay and provident fund. Again, with third daily tapping, fewer buildings are required. I conclude that the cost of production is exactly the same, but since you are getting only 82.6% of the crop, the loss from third daily tapping compared with alternate daily tapping is some 17½% of your profit.

MR J.E. HASTIE (Malakoff Estate, Kepala Batas, Province Wellesley). First, do the diagrams shown here represent an even proportion of the estates throughout Malaya? Second, when Mr Shearlaw was talking about bringing clonal seedling rubber into production at least a year earlier than budded rubber, he mentioned the figure of \$80 per acre for upkeep of immature areas in the sixth year. I think that figure is higher than it should be even allowing for leguminous covers throughout. This figure for upkeep has an important bearing on the estimate of the additional cost of bringing buddings into bearing.

MR SHEARLAW. First, the estates were evenly distributed from North to South. In answer to the second question, I do not think we are high at \$80.

MR BOON WENG SIEW. In view of the extra 17½% profit to be obtained from alternate daily as compared with third daily tapping, and in view of the unstable world situation and the desirability of replacing our trees by better planting materials, would it not be advisable to maximise our profits now by tapping seedlings at 100%

A Survey of Commercial Yields

intensity rather than to try to extend the life of the trees by tapping at 67%?

MR SHEARLAW. I do not think that one can vary the tapping system to meet changes in the international situation. If you tap d/3 and the price of rubber suddenly rockets up to \$1.40, you have to find the labour to change your tapping system and the money necessary to house them. If you want quick profits you can tap up to 133% or 200%; but that would depend on how long you wanted your trees to live and still give an economic return. You must also bear in mind those barren years when you have to replant and when you have expenses to pay but no income.

MR W.L. HARVEY (Sungei Wangi Group, Sitiawan, Perak). Neither the questioner nor Mr Shearlaw has brought out the point that we are really only comparing 100% and 67% basal tapping, and I imagine that practically every estate will go on to the high-level/low-level periodic 100% system when the trees are between the ages of fifteen and eighteen years, so that after that the comparison is not valid any more.

MR SHEARLAW. I agree. No one would consider tapping d/3 permanently with any type of rubber.

MR J.G. ALLAN (Gadek Estate Ltd, (Kupang Division), Baling, Kedah). I am very interested in the brown bast aspect of the question. Many people are forced into third daily or periodic tapping because of the incidence of brown bast, especially with clonal seedlings. You give a very high figure indeed for the yield of Gough Garden seedlings for one year. What is the incidence of brown bast going to be and shall we have to go on to a periodic 67% system to avoid an extensive outbreak of brown bast?

MR SHEARLAW. I do not know. It is too early to say what the brown bast incidence is going to be in Gough Garden 1.

MR ALLAN. Might it be judged from PBIGS?

MR SHEARLAW. Yes, possibly, but in my view the higher the yield the more prone your material is going to be to brown bast, and that applies to both seedlings and buddings.

MR ALLAN. Much more to the seedlings, I think.

MR SHEARLAW. I agree with you, you have a greater incidence of brown bast in seedlings than in buddings. Nevertheless the figures for pre-war PBIGS which you have seen compare well enough with the buddings which were contemporaries in breeding and age. I cannot see any reason why Gough Garden should not compare just as well with the buddings of the future.

MR ALLAN. I have experience of clonal seedlings other than PBIGS. We have been forced on to the 67% system after eight years, because we already have 18% of brown bast, despite the fact that thinning must have eliminated a good proportion of the disease. I estimate that average incidence is 20%. That would affect your argument a great deal

even if you only come down from 100% to 67%.

MR SHEARLAW. Yes, if you come down to 67% in middle aged rubber, I agree to a large extent, but we can legitimately hope that before very long the cause of brown bast will be ascertained and then it should be a much shorter step to find ways of reducing its effects. Your figure of 20% incidence of brown bast is considerably higher than I have found with PBIGS. We have four estates where we have very bad attacks of brown bast, and my personal view is that there is a connection between soil and brown bast, since the disease is found in patches.

MR ALLAN. The disease is in patches and it does particularly apply to high yielding trees. Sometimes, when opening the old types of seedlings, we very quickly found that a fair number of very high yielders immediately went dry. I used a quarter cut on these trees, on the opposite side to the original cut, and thinned out on that system. I eventually got 1200 lb per acre from that field.

MR P. DE JONGE (R.R.I.M.). I would like to add one point to this discussion of brown bast. I agree with you for tapping on a quarter spiral cut and I think it is highly important to take remedial action at an early stage. I have seen estates where they employ kanganies to work through the whole estate daily and mark all trees having partially dry cuts, so that the length of cut can be reduced. This is just a practical measure to keep trees yielding which would otherwise go completely dry. All clonal seedlings should in any case be tapped third daily.

MR B. GRAY (Prang Besar Estate, Kajang, Selangor). I do not know whether Mr Shearlaw heard Mr Allan's question quite clearly, but the yields of PBIGG 1 given in this paper are from continuous d/3.67% tapping. Would Mr de Jonge like to say whether very high yielding seedlings, giving 1600 lb per acre, would be liable to show a bad incidence of brown bast on 67% tapping?

MR DE JONGE. This is a very difficult question, but I would expect so.

MR J.E. BARTLAM (Sogomana Estate, Lumut, Perak). Could Mr Shearlaw inform us of the tapping task size for the various 100% systems and for the double cut system?

MR SHEARLAW. We experimented with task size up to as much as 650 trees a task in the post-war rubber where churns were collected, but we found 650 considerably too high. I would say that the optimum task is about 450 trees where the tapper has not much carrying to do and 500 trees where the tapper has nothing to carry except his knife and collecting bucket. For double-cut tapping 175—180 trees is the optimum. These optimum figures are roughly those used in the experiments reported here.

MR DE JONGE. On this subject of 67% tapping, you made a comparison between periodic tapping and third daily tapping and from that I gather you prefer third daily tapping to alternate daily periodic tapping of 67% intensity. That was more or less shown in your *Figure 1A*.

A Survey of Commercial Yields

It was shown in the yield per acre but not in the yield per tapper. This is especially true for PB 86. How can that be possible?

MR SHEARLAW. There are anomalies in these histograms as I have already said. I cannot explain why the yields are higher on continuous third daily than on 67% periodic.

MR DE JONGE. Third daily tapping is no doubt accepted as a good tapping system for this clonal seedling to keep the brown bast down, and periodic tapping would be a risk on clonal seedlings. We hope that periodic tapping will have a beneficial effect on girdling and therefore I want to ask you, are you on really safe grounds to prefer third daily tapping above alternate daily periodic tapping for, let us say, planting material which is relatively free from brown bast?

MR SHEARLAW. Yes, all the figures indicate that you get a higher yield on third daily than on periodic tapping.

MR BARTLAM. In comparing yields of seedlings and mixed clones, it appears that the mixed clones figures have been taken from relatively old types of buddings, PB 86, PB 186 and Tjir 1. Surely you could get results more favourable to the buddings by using clones such as PB 5/63 or PB 28/59?

MR SHEARLAW. The PBIGS seedlings were developed roughly at the same time as the clones. You will find a list of the number of recordings for each clone in *Appendix 1*. Now these clones were roughly of the same generation as the seedlings used in these pre-war plantings; the seedlings were all C, D and E. The early post-war clonal seedlings were still C, D and E, with F and G introduced a few years after the war. We now have Gough Garden 1. It is true that there may be clones that will give better yields than these, but I have still to find them. PB 5/63, on its early yield figures, looks as if it may give very good yields. The yield of the 1954 mixed clones in *Figure 6A* is from four of the newer Prang Besar clones, but of these four we have already discarded two. In fact few clones live up to their initial promise.

MR ALLAN. If you had mixed parentage in the early stage of breeding, is it not probable that your more recent seedlings will give very mixed results?

MR SHEARLAW. Perhaps Mr Gray could say something on this question.

MR GRAY. It is quite true to say that the greater the number of clones in a seed garden the greater the variability in the progeny. We have now come down to having far fewer clones in our seed gardens and we are coming down to three or four. Our new gardens will have far fewer clones than our previous gardens had and therefore the variability in seedling progeny will be very slight.

MR DE JONGE. We still have the question of when to introduce double-cut tapping. Mr Shearlaw's paper shows in *Figure 7* that the mixed buddings which had been tapped on a 67% intensity tapping system responded with a highly increased yield to the introduction of

2C/2.d/3.12m/16.100% tapping. He admits that such material has probably been undertapped in the past, but I think that material tapped at 100% intensity on a single cut has also been under-exploited, by not stimulating on bark of first renewal.

In our experiments we obtain lower yields per tree from 133% double-cut tapping than on 100% tapping on bark of first renewal with half yearly application of a yield stimulant. The yields shown on the histograms for 100% single-cut tapping could have been raised by 40% through half yearly stimulation. Furthermore, one tapper can deal with more trees when tapping two of the 450 tree tasks than when dealing with four double-cut tasks tapped 2C/2.d/3.12m/16.100% which cannot be larger than 200 trees each. I feel that budded planting material which is in good heart and has good bark of first renewal should be tapped S/2.d/2.100% on renewed bark, with regular stimulant application, before the double-cut tapping system is introduced. Would Mr Shearlaw agree with that?

MR SHEARLAW. I agree that you may very well be right on this point. We have no experience yet on the best time for introducing double-cut tapping. I agree that the yield of the single-cut 100% tapped fields would have been increased by application of stimulant. The same could probably be done when tapping on the double-cut system.

MR DE JONGE. Stimulation is not very effective when tapping continuously third daily on two cuts, but it may prove effective in combination with the double-cut third daily periodic system. This is now being tried out in five estate experiments. If it works, I think this system will certainly be a very useful one.

But what I want to stress on is that I feel that there should be a more generous use of stimulants now that stimulants can be used as a routine practice to give a marked reduction in tapping cost. If you do not want to do that, you can also tap at a lower frequency and still get the same yield per acre by using stimulants.

MR SHEARLAW. Yes, and you also reduce your general charges, because you need much less labour if you are using a periodic system of reduced intensity.

CHAIRMAN. As Mr de Jonge had said, we feel that there will be still more uses for yield stimulants than we have at present and also for the use of periodic systems, but work has only just commenced and we shall not have results for some time yet. If any of you think of trying out these new ideas, I would suggest that you do so on a very small scale.

MR A.T. ABBOT (Baling Estate, Kuala Ketil, Kedah). I would like to ask Mr Shearlaw whether he agrees that a higher yield per acre can be obtained by decreasing task size.

MR SHEARLAW. Yes, I agree, but you have to use your judgment as to where the economic optimum lies.

MR ABBOT. Is 450 trees per task the economic optimum?

A Survey of Commercial Yields

MR SHEARLAW. In my opinion 450 is about the optimum number of trees per tapper; he can finish very comfortably by half past ten in post-war rubber. Reducing the task to 250 trees will give a further increase in yield per acre, but in my opinion that increase will not compensate for the rise in tapping costs and in general charges entailed by the expansion of the labour force.

MR C. ROBINSON (Rinching Estate, Semenyih, Selangor). In considering the question of ideal task sizes there are numerous factors to be considered: topography, planting density, girth size, the position of the cut, the method of collection and not least the skill of the tapper. I have made a detailed time and motion study at Rinching. Actual tapping time per tree (cleaning the cup, removing scrap and excising bark) for a male tapper was 30.4 seconds, with a cut length of 20.5 in. and a cut height 35 in. above the ground. I allow 65 minutes walking time, 60 minutes rest or waiting period, 100 minutes collection time, 10 minutes for bucket cleaning and a variable time for reception and weighing. My study was done on pre-war pedigree rubber. I find that an ideal task for a tapper is in the region of 420 trees maximum, assuming an eight-hour day under relatively easy conditions of terrain and tractor and churn collection.

MR SHEARLAW. There is only a difference of about 30 trees between us. The important factor under present wages agreements is that you pay a very high rate for your first x lb while for subsequent production above that level you pay much less per pound. The implications are, I think, obvious.

MR S. SANDISON (14, Jalan Buloh Kasap, Segamat, Johore). I would like to say one or two things about clonal seedlings, especially in relation to what Mr Allan said about brown bast. After the war, I tapped clonal seedlings at 67% with half an inch of bark consumption per month. As soon as a tree showed signs of drying up, it was put out of tapping and rested. After six months, wherever possible, it was opened at the other side, at one-third of the initial length of cut and if necessary this was reduced to one-quarter. This year we are planting two clonal seed gardens with only two clones and I have no doubt whatsoever about the use of clonal seedlings and our ability to tap them successfully.

CHAIRMAN. May I add something to Mr Sandison's remarks. In most crops the most productive seedlings are true crosses from two parents, i.e. they are not 'selfed'. One of our very long term objectives is to produce rubber seedlings of this type from which selfed material is excluded.

Tapping Systems and Yield Stimulation on Three Estates

Paper presented by Chen Jan Jee, Managing Director, Lee Plantations Ltd, Singapore

As a result of the research in plant breeding by the Rubber Research Institute of Malaya, by similar institutes abroad and by research stations of the Malayan planting companies, the rubber planting industry to-day has a number of excellent high yielding clones that can stand up confidently to competition from synthetics. The potential of these clones however, can only be realised by suitable estate management such as proper holing, anti-erosion measures, covers, weeding and manuring.

COST OF TAPPING

Since the highest single cost in the production of natural rubber is unquestionably tapping, it is only natural for planting companies and planters to be deeply concerned with matters like the system and intensity of tapping, the supervision of the tapper, the quality of his work and the size of his task, tapping standard, manuring and cultivation practice, and other factors which, in an appropriate combination, would result in long term high productivity of the tapping areas. Extended productivity of the tapping areas would ensure high output per tapper and consequently low tapping cost. It should also be borne in mind that in this age of rapid political and social changes we have to plan not only for maximum crop in the minimum time, but also for high productivity per tapper in order to give the tapper a higher standard of living.

On an intensity of S/2.d/3.67%, the tapper's productivity will be high, but the crop per acre per year will be lower and the net profit to the proprietors will be less. An intensity of S/2.d/2.100% will generally give higher yields per acre per year than S/2.d/3.67%, and high yield per tapper can be achieved by giving the tappers a larger task from the start. A typical task of 450 trees is completed in 6 hours, 2 hours shorter than the normal working day in other industries. One reason for this relatively short working day is that in the past we believed that trees tapped in the early morning would yield far more than trees tapped in the latter part of the day. To-day we know that the difference in yield between a tree tapped at 6 a.m. and 5 p.m. is a matter of 12—15% only.

The cultivation of post-war replantings in Malaya is, generally speaking, on a standard far higher than ever before and yields from the high yielding rubber in the second and third year of post-war plantings have been so good that the tapper finds it difficult to carry the day's latex to the collecting stations. The day has come when the tapper's work should be limited to tapping and collecting his latex and carrying it to the road, whence the estate trailers would convey it to the collecting

Tapping Systems and Yield Stimulation

stations. Having considered all these factors, we have begun with tasks of 550 — 600 trees per tapper per day, depending on terrain. The tappers easily complete their tasks by 10.45 a.m. and collection starts at 11.15 a.m.

COSTS OF TAPPING AT SCUDAI AND SENAI ESTATES

Our Scudai Estate record of performance of clones, trees per task, year of tapping, total wages paid and cost of tapping per pound for January 1961 make interesting reading and can be found in detail in *Appendix 1A**. The cost of tapping per pound for the different clones in the different years of tapping (1 to 3 years) can be readily seen. The average cost was 16.9 cents per lb. 60% of the tappers are Javanese, 30% Indians and 10% Chinese. The basic wage for tapping is \$3.20 per day when the price of rubber is \$1.00 or less per lb and \$3.50 a day when the price is over \$1.00 per lb. An incentive on a sliding scale dependent on the price of rubber is given for any production above 20 lb Grade I on any day. A high standard of tapping is maintained and bark consumption averages 8 to 9 in. a year on S/2.d/2.100% tapping intensity. The soil varies from a sandy to a clayey loam. 'Cultivation' is an overall spray on all grass before manuring annually. Since late 1957, only compound fertilisers at the rate of 1½ lb per tree per year have been used. The height of opening was 60 in. from the union, with buddings opened at 18 in. girth. Stands vary from 145 to 160 trees per acre. Mean girth increments measured over a period of three years on 100 trees per block are 4.7 in. for RRIM 501 and 5 in. for Tjir 1, with PR 107 girthing as well as Tjir 1 in the same year of tapping. RRIM 501 at the completion of the third year of tapping is still free from trunk snap incidence.

The yields per tapper at our Senai Estate, on the same cultivation but with 600 trees per task on better soil, are 25 lb per day (all grades) for PR 107 at the end of two years of tapping (36 lb on the best day) and 38 lb per day for RRIM 501 (best day 46 lb) also at the end of the second year of tapping. Ch 26 yielded 15 lb per tapper (20 lb on the best day) at the end of the ninth month of tapping. The stand is 140 trees per acre. Girth increment data for these trees are given below:

<i>Clone</i>	<i>Girth at opening</i>	<i>Girth increment</i>
RRIM 501	17.50 in.	1.83 in. at end of second year
PR 107	18.65 in.	2.85 in. „ „ „ „ „
Ch 26	18.00 in.	0.99 in. „ „ „ ninth month

YIELDS AT SUNGEI PLENTONG ESTATE

Observations at our Sungei Plentong Estate are given below. The soil is sandy loam.

* Further data are given in the supplementary *Appendix 1B*

TABLE 1. SUNGEI PLENTONG ESTATE—JANUARY–JUNE 1961

Recorded data	PR 107		RRIM 501	
	(a)	(b)	(a)	(b)
Cut back	May 1953	Jan. 1952	May 1953	Jan. 1952
Tapping	Mar. 1959	Aug. 1957	Mar. 1959	Aug. 1957
Girth at opening, in.	over 19	over 18	over 19	over 18
Planted area, acres	42	20	36	20
Trees per acre	130	150	130	150
Trees per task	520	550	520	550
Yield Jan.—June, 1961, lb	15,356	6,509	19,943	10,398
Average yield per tapper January 1961, lb	27.23	27.08	32.82	30.84
Average yield per tapper June, 1961, lb	26.97	23.79	34.15	43.06
Average yield per tapper for Jan.—June 1961, lb	21.25	19.31	27.41	31.76

Stand and Yield

The yields of PR 107 and RRIM 501 on the following two systems were compared (see *Table 1*):

- a. (at the end of the second year of tapping) opened at over 19 in. girth at 60 in. above the union on a stand of 130 trees per acre and with a task of 520 trees;
- b. (at the end of three and a half years' tapping) opened at over 18 in. girth at 60 in. above the union on a stand of 150 trees per acre with a task of 550 trees a day.

There was little difference between the yield per tapper obtained by the

TABLE 2. YIELDS OF TWO CLONES AT SUNGEI PLENTONG

Both clones budded March 1953 and opened for tapping in March 1959. Girth at opening 19 inches

Clone	Year	Trees per acre	Task, no. of trees	Produc- tion, lb	Yield per acre, lb	Girth incr. in 2 years, in.
PR 107 (42 acres)	First	130	520	20,533	489	—
	Second	130	520	30,339	722	3.6
RRIM 501 (36 acres)	First	130	520	20,748	576	—
	Second	130	520	36,852	1,024	2.73

Tapping Systems and Yield Stimulation

two systems, but it should be noted that there was one year's difference in the age of the trees.

Yield of Recent Plantings

Yield performance of PR 107 and RRIM 501 on a very sandy loam at Sungei Plentong Estate (purchased April 1956) for the first and second year of tapping are given in *Table 2*.

Yield of Pre-war Plantings

Tapping system. In our Sungei Plentong Estate the change of tapping system from S/2.d/3.67% to S/2.d/2.100% resulted in higher yields from a block of eighty-eight acres of 1939 mixed buddings and clonal seeds on very sandy soil.

Manuring and stimulation. Manuring was an application of 4 lb sulphate of ammonia per tree in 1955 and again in 1957, followed by annual applications of 2 lb of compound fertilisers per tree in 1959 and 1960. Monthly yields for 1955 to 1960 (six years) are given in detail in *Appendix II* and are summarised in *Table 3*.

TABLE 3. YIELDS OF PRE-WAR PLANTINGS AT SUNGEI PLENTONG

<i>Year</i>	<i>Production, lb</i>	<i>Yield per acre, lb</i>	<i>Tapping system</i>	<i>Manuring per tree</i>
1955/1956	73,231	836	S/2.d/3.67%	4 lb sulph. amm.
1956/1957	90,706	1,035	S/2.d/2.100%	Nil
1957/1958	98,056	1,119	S/2.d/2.100%	4 lb sulph. amm.
1958/1959	103,132	1,177	S/2.d/2.100%	Nil
1959/1960*	132,676	1,514	S/2.d/2.100%	2 lb Nitrophoska Yellow
1960/1961**	135,079	1,541	S/2.d/2.100%	2 lb Nitrophoska Yellow

* Flomore 2,4,5-T yield stimulant applied in July 1959.

** Stimulex Formula II yield stimulants applied in July 1960.

From the detailed monthly production figures in *Appendix II* it can be seen that high yields have been maintained from one application of stimulant to the next application a year later. As the tappers are the same throughout, the benefits of yearly manuring with 2 lb Nitrophoska Yellow in 1959 and 1960 cannot be ignored. These 1959 and 1960 manurings were applied a month after application of the yield stimulant.

APPENDIX IB* YIELD BY BLOCKS JANUARY—JUNE 1961. SCUDAI ESTATE

Block	Planting material	Av. trees per task Jan. - June	Acreage tapped Jan. - June	Jan., lb	Feb., lb	Mar., lb	April, lb	May, lb	June, lb	Total, lb	Monthly average per acre
A	Tjir 1	569 - 596	22½ - 30	1,640	1,158	771	1,461	1,435	1,937	8,402	53.3
A	RRIM 501	571 - 573	9 - 14	549	480	557	920	950	1,088	4,544	56.8
B	RRIM 501	578 - 586	36 - 45	3,870	3,268	2,624	3,340	4,320	4,923	22,345	91.9
C	RRIM 501	592 - 592	13½ - 19	1,363	1,098	774	984	1,370	1,772	7,361	75.7
C and D	PB 86	484 - 562	45 - 75	2,217	2,752	2,497	2,221	3,209	3,957	16,853	42.4
E	RRIM 501	558 - 590	34½ - 34½	2,750	2,628	1,959	1,671	2,569	3,338	14,915	72.0
F	PR 107	564 - 582	70 - 91½	5,054	4,374	3,193	3,762	4,863	5,801	27,047	56.6
G	PR 107	572 - 589	53 - 66	3,022	2,215	2,109	2,445	3,294	3,755	16,840	45.9
H	PR 107	591 - 591	59 - 59	3,629	2,795	2,326	2,137	3,014	3,790	17,691	50.0
H	Tjir 1	556 - 556	20 - 20	1,244	1,029	612	533	690	835	4,943	41.2
I	Tjir 1	581 - 583	42 - 66	2,611	1,840	1,395	1,276	1,683	2,352	11,157	34.1
I	Tjir 1	555 - 537	25 - 35½	1,080	739	808	811	1,138	2,002	6,578	36.4
J	Tjir 1	530 - 566	55 - 55	960	807	747	776	846	1,187	5,323	16.1
J.1	Clonal seed	523 - 556	40 - 45	1,570	1,488	1,268	1,315	1,695	2,192	9,528	36.7
K	Clonal seed	497 - 564	35 - 48	1,392	1,047	976	1,067	1,280	1,824	7,586	32.2
K.1	Tjir 1	556 - 556	49½ - 49½	2,517	2,137	1,998	1,908	2,281	3,256	14,097	47.4
Sg. Dangar	Tjir 1	586 - 586	25 - 25	1,083	996	848	700	1,007	1,073	5,707	38.0
" Extra	PR 107				3,297	1,247	2,440	3,513	3,202	13,699	—
Total			634 - 778	36,551	34,148	26,709	29,767	39,157	48,284	214,616	

Additional data for each month

	Jan.	Feb.	March	April	May	June	Jan. - June
Total wages, dollars	6,191.43	5,729.87	7,074.29	6,759.65	7,699.44	8,598.90	42,053.58
Cost per pound, cents	16.9	16.8	26.5	22.7	19.7	17.8	19.6†
Number of tasks	134	144	148	158	171	172	—
Percentage of scrap	9.6	13.6	13.1	13.9	11.1	9.9	11.6†
Number of acres tapped	634	671½	676½	726½	774½	778	—
Average per acre per month, lb	57.6	50.8	39.5	41	50.6	62.1	—

* Supplement to Appendix I A. † Average

APPENDIX II. SUNGEI PLENTONG ESTATE. MONTHLY CROP STATEMENT IN POUNDS FOR 87.65 ACRES
(PRE-WAR PLANTINGS)

G1 1, Tjir 1, Pil D65, PB 25, PB 86, Pil B84 and PBIG Clonal Seedlings. 1955/56 under third daily tapping.
1956/57 onwards alternate daily tapping.

Month	1955/1956	1956/1957	1957/1958	1958/1959	1959/1960	1960/1961
April	5,156	6,759	7,547	7,284	8,101	9,826
May	5,518	6,547	8,651	6,358	9,253	10,806
June	4,990	8,632	9,131	7,527	9,619	11,363
July	4,995	7,529	8,246	9,424	13,289*	13,711**
August	5,331	7,313	8,006	8,839	13,178*	12,556**
September	5,713	6,303	8,358	9,331	12,816	11,511
October	6,019	7,868	7,724	9,609	13,026	12,252
November	6,089	6,344	7,807	9,344	11,258	12,161
December	6,912	8,491	7,205	10,543	11,042	10,808
January	7,414	8,464	9,101	8,381	10,686	10,872
February	8,515	8,324	7,608	8,688	9,572	9,519
March	6,579	8,132	8,672	7,894	10,836	9,694
Total	73,231	90,706	98,056	103,132	132,676	135,079
Average per month	6,103	7,559	8,171	8,594	11,056	11,257
Yield per acre	836	1,035	1,119	1,177	1,514	1,541

* 'Flomore' 2,4,5-T applications ** 'Stimulex' Formula II applications.

Tapping Systems and Yield Stimulation

DISCUSSION

*Chairman: Mr C.W. Brookson, Head of the Botanical Division,
R.R.I.M.*

MR R.D. STONEHEWER (Sedgeley Estate, Kajang, Selangor). Are the costs in these tables based on M.P.I.E.A. rates?

MR CHEN. As you will see under 'Costs of Tapping' in my paper, the basic tapping wage is \$3.20 or \$3.50 per day, according to the price of rubber. When the price is \$1 or less, I pay \$3.20 per day and that is for the first 20 lb; the tappers are paid an incentive of 5 cents a pound for any additional poundage of RSS 1. If the wage bill appears high, bear in mind that we are giving the tappers more trees; certainly we have to give them more money, and the rates are not M.P.I.E.A.

MR T.E. HASTIE (Malakoff Estate, Kepala Batas, Province Wellesley). I would like to ask Mr Chen if any girth increment records were kept after tapping was commenced.

MR CHEN. The girthing figures are found in *Table 2*. The figures are for trees that are tapped; we do not take the girth measurement figures of untapped trees.

MR W.L. HARVEY (Sungei Wangi Group, Sitiawan, Perak). The yields from the areas which were opened two or three years ago may not be particularly good of course, but on the average they would compare with average yields in any part of the country. The yields from the prewar rubber, tapped on 100% intensity, are really very excellent for any area. I would like to know the position of the yield stimulant application in relation to the tapping cut.

MR CHEN. The applications were made on a band about $3\frac{1}{2}$ in. wide, immediately below the cut.

MR C. ROBINSON (Rinching Estate, Semenyih, Selangor). Does Mr Chen think that the removal of 8 to 9 in. of bark (mentioned in his paper) is conducive to obtaining an optimum yield.

MR CHEN. When opening up at 18 in. I would say that 8 to 9 in. bark consumption is correct, but when trees get older, I suppose 10 in. a year would be more suitable. Remember that we open at 18 in. and that we have manured with compounds at $1\frac{1}{2}$ lb per tree per year since 1957. That is our policy for the first six years of tapping, after which we will review our whole policy.

MR K.M.S. STIMPSON (Carey Island, Port Swettenham, Selangor). Mr Chen mentions a stand of 130 and 150 trees per acre in fields opened at 18 to 19 in. Were all these trees in fact brought into tapping? The yield per acre is not particularly high.

MR CHEN. We open up when 80% of the trees have a girth of 18 to 19 in. When we talk of yield per acre, I think you will agree that soil is the deciding factor. The soil at Sungei Plentong is very sandy.

MR V.V. CHELLAM (Rubber Estates of Malaya Ltd, Kota Tinggi, Johore). Is there any record of wind damage after opening the trees in the RRIM 501 areas at 18 in.?

MR CHEN. As stated in my paper, the estate is free from trunk snap

at the completion of the third year of tapping.

MR J.R. GARDNER (Rasa Estate, Rasa, Ulu Selangor). Mr Chen has mentioned that he stimulates $3\frac{1}{2}$ in. of bark once a year. I think the R.R.I.M agrees that the effect of 2,4,5-T only lasts approximately four months. Would he not get a better result if he stimulated twice a year?

MR CHEN. I think I would, and we have plans to stimulate twice this year.

MR STONEHEWER. Is there any indication that stimulating pre-war, but not very old rubber, increases brown bast incidence? Does Mr Chen think that there will be more brown bast, if he stimulates twice a year?

MR CHEN. No, the trees are very healthy, and so far we have no brown bast.

CHAIRMAN. Could Mr de Jonge say something on this subject?

MR P. DE JONGE (R.R.I.M.). As far as we know there is no relationship between brown bast and yield stimulation. Of course if the stimulant is applied too thickly, the trees may dry up but that is through rotting away of the treated strip of bark before it has been tapped off.

MR E.S. TREVOR (New Labu Estate, Nilai, Negri Sembilan). In the section on 'Yield of Pre-war Plantings' the very high yield of 1959 — 60 is attributed to Nitrophoska Yellow. Would Mr Chen expect the increased yield to have come in 1959?

MR CHEN. I do not necessarily attribute the extra yield to Nitrophoska. I merely said that the benefits of yearly manuring with 2 lb Nitrophoska in 1959 and 1960 could not be ignored. It so happened that during that period we changed to yearly manuring with 2 lb Nitrophoska per tree, as against the policy of the former owners which was to apply pure sulphate of ammonia every two years at a rate of 4 lb per tree.

DR G.A. WATSON (R.R.I.M). I think that the higher yields are unlikely to be due to the application of Nitrophoska in 1959 and 1960. It is possible that the applications of sulphate of ammonia in 1955 and 1957 did contribute to the increase and I think that the general health of the trees would enable them to respond to the stimulation. In this case, I would attribute the extra yield to stimulation.

As for the soils at Sungei Plentong, I saw them recently, and we would describe them as granite-derived soils of only a rather moderate quality.

MR G.F. STOOKS (Bukit Dinding Estate, Karak, Pahang). What are the planting distances, with particular reference to RRIM 501?

MR CHEN. For RRIM 501 we have planting distances of 22×11 , 30×7 and 18×12 ft, thinned out to 150 and 130 trees per acre.

MR P.W. SHEARLAW (Harrisons & Crosfield, Kuala Lumpur). Mr Chen has told us that his bark consumption is 8 to 9 in. a year and his stimulated band is $3\frac{1}{2}$ in. That means to say that the stimulated band represents roughly five months' tapping. Now as I understand it, the stimulated bark should be tapped off in about three months. Has Mr Chen found any adverse effect on the bark, in the way of flaking, cracking or rotting, in the fourth and fifth month of tapping this stimulated band?

Tapping Systems and Yield Stimulation

MR CHEN. No trees have gone dry, nor has any bark rotted. The bark consumption on the older trees which are being stimulated is 10 in.

MR J.G. ALLAN (Gadek Estate Ltd, (Kupang Division), Baling, Kedah). I should like to know the authority for the statement in the first page that the difference in tapping between 6 a.m. and 5 p.m. is 12 — 15%.

MR CHEN. I think it will be about 16%.

MR DE JONGE. That is correct. The figure for afternoon tapping is exactly 84% of the morning yield, i.e. there is a difference of 16%.

MR ALLAN. Have you tried the effect of tapping smaller tasks on yield per acre?

MR CHEN. We have retained smaller tasks only on our older rubber.

MR STIMPSON. Mr Chen says that tasks of between 550 trees and 600 trees per tapper are finished by 10.45, which presumably gives a rate of somewhere between 120 and 150 trees per hour. Is tapping started before daylight?

MR CHEN. All the tappers are at their tasks by 6.15 in the morning and from our timing and actual experience over 750 acres, the tapper on the average gets over his 550 to 600 trees in about 210 minutes. I would like to ask whether anyone here has tapped tasks of this size.

MR BOON WENG SIEW (Malaka Pinda Estate, Alor Gajah, Malacca). I can give some information in support of Mr Chen's system of tapping. I also come from an estate where the girth at opening is 18 in. and where the task size is usually 550 to 600 trees. I have an area of 51 acres (Tjir 1 and PB 86) cut back in January 1955 and opened for tapping in August 1959; on the basis of the June yield, the yield per acre per annum would be about 939 lb. The task in this case is 450 trees, the yield per tapper 22.93 lb and the tapping cost 14 cents per lb. The average girth in June was 23 in. June is not the month of optimum yield and I quote these figures to show that opening at 18 in. does not have any detrimental effect. In an area of Tjir 1, after three months of tapping, we took the girth measurements of trees opened at 18 in. or more and also of trees which could not be tapped. There was no difference in girth increment between the tapped and untapped trees.

MR STOOKS. I should like to ask R.R.I.M. staff if they can explain why RRIM 501 opened at 18 in. has maintained its girth increment and remained unbroken.

CHAIRMAN. We should like to find out what factor stops trees from breaking. There is an area on the way to our Experiment Station opened between 17 and 18 in. and there was severe damage.

MR CHEN. I opened my talk by saying that we should co-operate in pooling our knowledge in the face of competition from synthetic rubber. Our estates would welcome any visit which would help any of us here in his work as a planter. We could not of course arrange for a series of individual visits. I would therefore suggest that the various Planting Associations could approach our Johore Planters' Association. In this way visits by groups of any size could easily be arranged. Our estates are open to any planter in Malaya.

Tapping of Young Rubber

Paper presented by P. de Jonge, Botanical Division, Rubber Research Institute of Malaya

The time which elapses between planting rubber and opening for tapping is commonly called the period of immaturity. This is an unproductive period during which costs accumulate without return of revenue, and it is obvious that the duration of this period should be kept at a minimum.

Plant breeders are well aware of this and try to produce material which combines high yield capacity with good capacity for growth. Investigations on methods of planting and husbandry, and also the recent success in propagating *Hevea* by cuttings on an experimental scale, may assist in reducing the period of immaturity.

GIRTH AT OPENING

There remains however, the problem of the minimum girth at which rubber trees should be opened for tapping. Some companies still prefer to open early at a girth as small as 18 in. at the height of opening, but on the other hand there is also a growing tendency to delay the first tapping. The argument for delayed opening is that strong trunks will be produced and that the initial loss in yield will be compensated for by high yields from the better developed trees. There is indeed a high positive correlation between girth and yield within a budded field of a given age, but there are several observations which suggest that postponement of tapping may cause only a temporary boost in yield, followed by a decline to a level normal for planting material of a particular type and age. The high yields experienced after the war were followed by years of reduced yield per acre, whereas fields which are opened at the standard recommended girth of 20 in. at the height of opening show an increase in yield both per tree and per acre during the first five years of tapping. It appears therefore that there may be an ideal stage of development, (possibly determined by the age of the tree) at which tapping should begin, and after which further postponement of opening will fail to bring about a sustained increase in yield.

We have a 'size at opening' experiment in progress on an estate; it is too early for conclusions to be drawn from the results, but it can be said that the experiment is eventually expected to settle the problem, at least in its broad outlines.

The subject of delayed opening would not have been raised if the growth performance of high yielding rubber trees had always been satisfactory; the relatively slow growth of modern high yielding rubber, with particularly unfortunate results in the case of clone RRIM 501, has stressed the need to avoid premature opening.

Poorly girthed trees at a high stand per acre may give a high yield per acre (not per tapper), but are a source of considerable risk in that root diseases or other environmental factors may create open spaces in

Tapping of Young Rubber

the stand. Dense stands give rise to high branching and as soon as an opening removes support from individual trees or groups of trees, severe wind damage may be experienced.

It is therefore almost generally agreed that with high yielding planting material one should aim at the best possible girthing, within the limitations set by the other factors determining the optimum stand for commercial exploitation. Sustained and well-balanced manuring and careful upkeep are of course essential if steady growth is to be maintained. A less obvious, but equally important factor influencing the growth of the rubber tree is the system of exploitation adopted.

TAPPING SYSTEM AND GIRTH

It is assumed here that the planter will not delay the opening of a budded area for tapping once 70% of the stand has attained tappable girth (which should be at least 20 in.) and that trees of a smaller girth will be opened at a later date.

Clonal seedlings can be omitted from discussion at this stage, as they generally show a satisfactory growth during tapping and are not especially susceptible to wind damage. There are, however, several clones of high yield capacity and good vigour during immaturity whose girthing is severely checked by tapping. Such clones are likely to develop in an unbalanced way (as described in *Planters' Bulletin* 43, July 1959, p. 85) if no effort is made to improve the rate of girthing during tapping. An account is given below of our enquiries into the effect of tapping systems on growth.

The S/2.d/3.67% Tapping System

Yield data and girth increment figures from large scale experiments planted after the war are given in *Table I*. If the degree of check in growth were determined only by the amount of latex withdrawn from the tree, then a reduction in tapping intensity would have a positive effect on growth, but it is clear that a reduction in tapping intensity from S/2.d/2.100% to S/2.d/3.67% does not give the desired extra rate of girthing during the early years of tapping, although yield is reduced by approximately 20%. It remains to be seen whether a reduction of intensity by means of introducing a periodic rest will have any beneficial effect.

Periodic Tapping

Some information on the effect of alternate daily periodic tapping on girthing has been published in the correspondence columns of *Planters' Bulletin* 54 (May 1961) and several experiments have been started in which the effects of periodic and continuously tapped systems, and also of delayed opening, are compared.

It is obvious that if we wish to achieve the best possible girth in a field of rubber trees, no tapping should be done at all! It is therefore necessary, in order to assess the restrictive effect of exploitation on

TABLE I. COMPARISON BETWEEN S/2.d/2.100% AND S/2.d/3.67%
Girth increment in inches and yield in pounds per acre per year

Planting material	Tapping system	Year of tapping									
		1st year		2nd year		3rd year		4th year		5th year	
		girth, in.	yield, lb	girth, in.	yield, lb	girth, in.	yield, lb	girth, in.	yield, lb	girth, in.	yield, lb
PB 86	S/2.d/2.100%	1.2	887	1.1	993	1.2	1037				
	S/2.d/3.67%	1.2	745	1.2	798	1.3	839				
PBFP	S/2.d/2.100%	2.1	720	2.4	1063	1.6	1207	1.5	1740		
	S/2.d/3.67%	2.1	603	2.3	860	1.8	856	1.6	1456		
Gl 1	S/2.d/2.100%	1.5	1068	1.6	1188	1.1	1128	1.2	1128	0.7	1020
	S/2.d/3.67%	1.5	852	1.5	996	1.2	972	1.4	1116	0.8	972
PB 86	S/2.d/2.100%	girth increment Aug. 1958 — Nov. 1960 mean yield per acre per year				=		=		2.5 in. 888 lb	
	S/2.d/3.67%	girth increment Aug. 1958 — Nov. 1960 mean yield per acre per year				=		=		2.5 in. 767 lb	

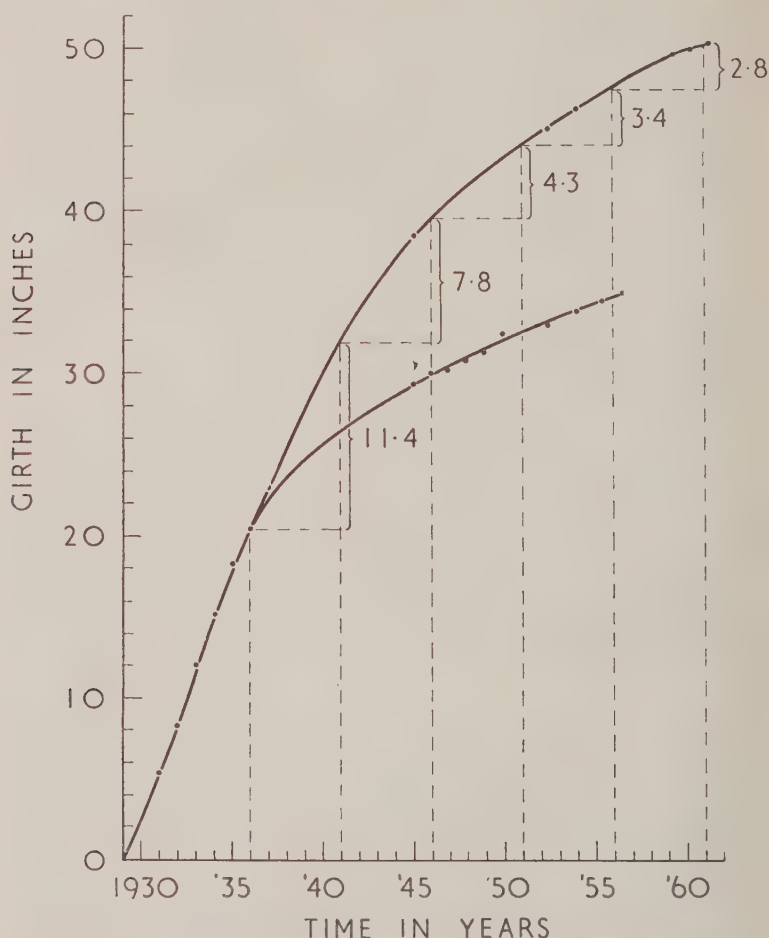


Figure 1. Girth increment of tapped (lower curve) and untapped budded trees. Mean of nine clones.

growth, to compare the development of tapped and untapped trees. Information on the growth of untapped and tapped trees has been obtained from a pre-war clone trial in which the corner trees of each plot were left untapped. *Figure 1* shows the growth trends of these trees, making it quite clear that if there is a tapping system which gives the trees a better chance to develop, it should be used during the period in which the trees have the highest growth capacity (as indicated by the growth curve of the untapped trees). The rate of growth of recommended modern clones under reasonable environmental conditions is higher and the check in girthing on tapping often more severe than

indicated by the graph, which is based on a clone trial in which eight of the nine clones are now obsolete and which was planted on a particularly poor sandy soil.

From the information available so far, it is thought that clones which are vigorous during immaturity but show a poor increment after tapping may benefit from periodic alternate daily tapping systems such as S/2.d/2.6m/9.67%. On the other hand it is probable that clones which are vigorous in immaturity and grow satisfactorily after tapping should be tapped continuously (S/2.d/2.100%).

A classification of clonal reactions to alternate daily tapping of a half-spiral cut (S/2.d/2.100%) has been published for the RRIM 600 series clones in *Planters' Bulletin* 48 (May 1960) and information is being collected on other clones. Experiments have been designed to study periodic tapping systems on a series of clones, but priority is given to RRIM 501.

In one experiment we even go to the extreme of tapping alternate daily for four months and then resting the trees for four months (S/2.d/2.4m/8.50%). One application of a yield stimulant will be given during each period of tapping in an effort to make up for the loss in yield suffered through reduction of tapping intensity. It is expected that the depressive effect of stimulation on girdling will be small for clones which already girth poorly during tapping and that the beneficial effect of rest will be marked, at least if the clone has a good growth capacity. If successful, such experiments may provide us with additional means of reducing the costs of production. We aim at as few tapings as possible, through the greatest possible use of yield stimulant.

It is probably necessary to accept a loss of crop in order to improve tree growth and consequently to reduce the risk of trunk snap. This loss, however, need not be extended beyond the period of good growth capacity (see *Figure 1*). It is suggested that in practice reduced intensity of tapping should be restricted to the first panel of virgin bark (6 — 7 years of tapping), after which full intensity tapping should be resumed if the price of rubber is favourable.

Summarising, it is hoped that the use of alternate daily periodic tapping systems may obviate the need to postpone the tapping of those clones which tend to grow in an unbalanced way when tapped continuously after opening at the present recommended girth of 20 in.

Tapping the Second and Subsequent Panels

The second panel of virgin bark should be tapped alternate daily on a half-spiral cut. The response of this panel to stimulant application is being studied.

The third panel (first renewal) should also be tapped alternate daily and we now have sufficient information available to recommend routine application of stimulant at intervals of six months when tapping this panel, as is already recommended when tapping the fourth panel.

It is, however, not yet certain whether the fourth panel should be

tapped alternate daily, with half yearly stimulant application, or whether a high panel should be opened and the tree tapped on the double-cut third daily (possibly periodic?) system. However these considerations are more relevant to the tapping of mature trees, which is not the subject of this paper. The present RRIM recommendation is to tap out the fourth panel (second panel of bark of first renewal) with half yearly stimulant application before introducing double-cut tapping.

Tapping Systems for Clonal Seedlings

It has been stated already that clonal seedlings normally grow satisfactorily during tapping, but unfortunately they are rather prone to brown bast. Third daily tapping is recommended for clonal seedlings from the moment of opening. Since the use of this system has kept brown bast incidence low (with a few exceptions) and permits satisfactory growth, there seems little point in considering alternate daily periodic tapping — a system which may lead to higher brown bast incidence.

The present RRIM recommendation for tapping clonal seedlings is: open the first panel at a height of 20 in. when 70% of the stand has reached a girth of 22 in.; tapping to be done third daily on a half-spiral cut (S/2.d/3.67%). The second panel should be opened at 40 in., the third at 50 in., and stimulant should be applied when the virgin bark island is tapped. The fourth panel should be opened at 40 in. (in renewed bark) with routine half yearly stimulation. After this panel has been tapped out, double-cut third daily (possibly periodic?) tapping should start.

YIELD STIMULATION

Combination of tapping systems with stimulant application is rapidly becoming a routine estate practice. There is little chance, for the time being, that a new yield stimulant, superior to those now available, will be developed. We are experimenting with combinations of antibiotics and 2,4,5-T, but so far there have been no new developments of interest to the planter.

The use of yield stimulants makes it possible either to obtain an increased crop per acre without increasing tapping costs or to obtain a normal crop per acre at reduced costs of tapping. The price of rubber and the cost of labour will determine which policy should be followed.

Immediately after the discovery of these formulations, it was a commonsense precaution to use stimulants only on old trees scheduled for cutting out. Our experiments since then, however, have shown that trees of over eighteen years of age may be treated at half yearly intervals as a routine practice.

In a recently completed experiment which has been in progress from August 1955 to January 1961, a comparison was made between various frequencies of stimulant application. The trees were high yielding clonal seedling trees planted in 1930, tapped on renewed bark from August

1955 until November 1958, and subsequently on high panels. The tapping system was alternate daily tapping on a half-circumference cut.

The mean yields per tree per tapping of the various treatments over the full five and a half year period are given below. The percentage additional yields obtained by stimulation are shown in brackets.

<i>Treatment</i>	<i>Yield, grams/ tree/tapping</i>	<i>Yield, lb/ acre/year</i>
Control	33.4	924
Monthly application above cut	41.2 (+23%)	1128
Below cut at intervals of 3 months	51.3 (+54%)	1410
Below cut at intervals of 6 months	45.3 (+36%)	1242
Below cut at intervals of 12 months	42.6 (+28%)	1170

This experiment shows that we have not yet realised the full potential of the existing formulations. No unfavourable secondary effects of increased frequency of stimulant application were noted.

Yield stimulants make it possible to tap on periodic systems of reduced intensity without losing crop, both on young and fully mature trees. The effect of one stimulant application in combination with the 2C/2.d/3.12m/16.100% system is being studied in five experiments laid down in 1960. This system is being compared with 2C/2.d/3.12m/16.100% without stimulation and with 2C/2.d/3.133% tapping.

It is known that the response to stimulant application improves as tapping intensity decreases. The disappointing response found after 1½—2 years when tapping 2C/2.d/3.133% will probably not be experienced when tapping on the periodic double-cut system of 100% intensity and it is quite possible that two applications of stimulant per tapping period would be more effective than one application.

The response of young trees stimulated from the moment they were opened for tapping is disappointing. This has been shown in two experiments, one carried out on Prang Besar Further Proof seedlings and one on clone PB 86. The girthing of the vigorous seedlings, but not of the slow growing clone PB 86, was markedly depressed.

A similarly disappointing response to stimulant application by young trees has been noted by other research units in Malaya.

Small scale experiments are at present in progress on clone Tjir 1 in which a stimulant was applied when the trees had been in tapping for two years; there has been a marked response to stimulant application. We wish, however, to avoid depressing the girth increment in the early years of tapping, and experiments have therefore been started in which stimulant is used on young trees which are tapped on periodic alternate daily systems of low tapping intensity.

This work on young trees is still in the experimental stage; we do not yet recommend the use of stimulant on young trees tapped on virgin bark, but hope eventually to develop a more economic tapping policy, to include yield stimulation, for this type of material.

Tapping of Young Rubber

DISCUSSION

*Chairman: Mr C.W. Brookson, Head of the Botanical Division,
R.R.I.M.*

MR R.D. STONEHEWER (Sedgeley Estate, Kajang, Selangor). What are Mr de Jonge's ideas on the stimulation of young rubber? Presumably one would not stimulate rubber between eleven and twelve years old.

MR DE JONGE. We now have sufficient evidence to recommend stimulant application when bark of first renewal is tapped; in the case of buddings that means after eleven years of tapping.

MR D.M. GOLD (Dusun Durian Estate, Banting, Selangor). What are the effects on scrap percentages of different task sizes and of stimulant applications?

MR DE JONGE. In an experiment on Tjir 1 seedlings we have found no effect of task size (varying from 300 to 600 trees) on scrap percentage. I believe stimulation can effect scrap percentage; during the period of boosted yields, after application of stimulants, it is advisable to have a second collection of latex.

MR GOLD. Would Mr de Jonge not have expected larger task sizes to have affected scrap percentage?

MR DE JONGE. I had expected a change. Our experiment is with a reasonably high yielding seedlings family Tjir 1. With very high yielding clones one might possibly find a disturbing amount of late dripping with the larger tasks.

MR GOLD. Has Mr de Jonge any information on the optimum length of dripping time between completion of tapping and collection?

MR DE JONGE. Not so far. The question did not arise with Tjir 1 seedlings, but we should welcome information on other planting materials.

MR V.V. CHELLAM (Rubber Estates of Malaya Ltd, Kota Tinggi, Johore). On renewed bark, would Mr de Jonge recommend stimulation above or below the tapping panel?

MR DE JONGE. That depends on the quality of the renewed bark. If you have a good thick renewed bark I would recommend you to apply the stimulant to lightly scraped bark, below the tapping panel. If you have poor renewed bark (say bark of the second renewal), it is better to apply above, because the scraping will probably damage the latex vessels in such a thin layer of bark.

MR I.T. STEVENSON (Sungei Chinoh Estate, Trolak, Perak). Mr de Jonge has said here that the R.R.I.M. recommends opening heights for seedlings of 20 in. for the first panel and 40 in. for the second. Would a reduced height of 30 in. for the second panel give an increased girth and possibly an increased yield?

MR DE JONGE. Yes, but then the virgin bark island effects will be increased. It is mainly to overcome this repressive effect on yield of tapping through virgin bark islands, that we recommend opening at

40 in. After the first panel of virgin bark has been tapped, the girth at a height of 40 in. should be 20—22 in., provided the seedlings have been properly managed.

MR R.F. CAREY (Pajam Estate, Mantin, Negri Sembilan). Does Mr de Jonge agree with me that it is not always possible to get a full return from daily periodic tapping systems. I have an experiment in which I use a 30 day tapping, 30 day rest system, but daily tapping is not always possible during rainy periods.

MR DE JONGE. I agree that this system appears to have a very disappointing result on your estate. This is a rather interesting point because so often it is said that daily periodic tapping of clonal seedlings will give better yields, whereas in this particular case it does not.

MR J. VEERSEMA (Buloh Akar Estate, Parit, Perak). Mr de Jonge has said that it is preferable to make a double collection to keep the percentage of scrap down. Would it not be more advisable to stimulate on the ABC system (in which only one third of each task is stimulated at one time) and make the tapper tap the recently stimulated section first all the time? This would allow a larger time for dripping from the stimulated trees which would be tapped relatively early in the day.

MR DE JONGE. I agree that the system is good, although I doubt whether it would be easy in practice to have the tasks tapped in the way you describe. The results of an R.R.I.M. experiment in which one third of each task was tapped per month is described in *Planters' Bulletin* 51, November 1960. We found that a second collection was still required during the peak yield period after stimulation.

MR J.E. BARTLAM (Sogomana Estate, Lumut, Perak). I have been practicing this ABC system for the last two or three years and I still find that afternoon collection is necessary, despite the fact that only one third of each task is stimulated each month.

MR T.E. HASTIE (Malakoff Estate, Kepala Batas, Province Wellesley). Has Mr de Jonge done any experiments on clone Tjir 1 with a 15-day tapping period and a 15-day resting period?

MR DE JONGE. It was done by the R.R.I.M. before the war. There were two experiments. One showed a good response in yield by clone Tjir 1, and the other one was inconclusive. Planting experience shows in general a favourable response by clone Tjir 1, but if you introduce this system from the moment of opening it will interfere with girthing. Daily tapping for a period of a month seriously reduces girthing of young buddings.

MR HASTIE. That is tapping for 30 days, not 15.

MR DE JONGE. Yes, 30 days out of 60.

MR HASTIE. I was tapping for 15 days and resting for 15 days in a month, a method which might overcome Mr Carey's difficulty in daily tapping. Heavy rain can prevent daily tapping during the 15 days but one can tap for more than 15 days to compensate for the loss of tapping days.

Tapping of Young Rubber

MR D. SELBY (Jasin Lalang Estate, Jasin, Malacca). Has Mr de Jonge any idea of the ideal season for resting trees tapped on a periodic system? I am thinking in terms of girthing.

MR DE JONGE. I think there may be an ideal period for resting the tree. One would not expect the tree to girth very well during the wintering season. On the other hand, from the point of view of yield, that would be the ideal resting period. If that is so a compromise may have to be sought. The answer to this question should eventually be provided by current experiments in which we take the girth measurements at constant intervals. Strangely enough, if one considers the half-yearly records of girth measurements one finds the best girthing from January to July, a period which includes the wintering season. We are now collecting quarterly records which should throw some light on the problem.

MR L.A. WORLEY (Harrisons & Crosfield, Kuala Lumpur). Is there anything to show that the height of the tapping cut affects girth increment?

MR DE JONGE. No work has been done on this subject, as far as I know.

MR BOON WENG SIEW (Malaka Pinda Estate, Alor Gajah, Malacca). On buddings twenty-three years old and tapped third daily on a double panel, is it advisable to apply stimulant on the top panel?

MR DE JONGE. No, not as a long term procedure. In our experiments we found that on double-cut third daily 133% tapping there was a good response to stimulation during the first year of tapping, but after a time there was no response whatsoever, and eventually the yield fell below that of the unstimulated trees. On the other hand, with the periodic system when the rest period reduces intensity to 100%, stimulation and double tapping may be compatible; we have experiments to investigate this point.

MR STONEHEWER. On the subject of wintering, what is the best period to apply fertilisers, supposing your wintering month is April?

DR G.A. WATSON (R.R.I.M). We find that the uptake of fertilisers is more effective if they are applied just before refoliation. Thus if your trees were to refoliate in April, you would have to apply your fertiliser in February or March to get optimum results.

MR HASTIE. If we put down two applications per annum on mature rubber, one just before refoliation, when would be the best time to put down the second application?

DR WATSON. It is best to avoid the heavy rainfall late in the season. In Johore, you could probably apply the fertiliser at any time between August and November. Further north it will be advisable to apply it before the heavy rains in September—November.

MR VEERSEMA. Could Mr de Jonge say whether he knows of any experiments on stimulating pre-war Gl 1. It is often said that Gl 1 should not be stimulated.

MR DE JONGE. Gl 1 is a very variable clone. Where it yields well it can be stimulated in the usual way. I know of estates which have stimulated Gl 1 with very good results indeed, especially on a high panel.

MR G.F. STOOKS (Bukit Dinding Estate, Karak, Pahang). Mr de Jonge says stimulation on 2C/2.d/3.133% is ineffective. Why is it necessary to use this system at all when we get an increased yield by tapping on a single high cut with stimulation?

MR DE JONGE. The disadvantage of ladder tapping is that the task is small compared with double-cut tapping. One tapper tapping alternate daily on a high panel cannot cope with more than 600 trees, i.e. two tasks of 300 trees. With double-cut tapping, he can cope with four tasks, three tapped and one resting and the number of trees he deals with is far greater than on ladder tapping. A further disadvantage of ladder tapping is the rapid consumption of virgin bark on the high panels. The second high panel will be facing a previous high panel of rather young renewed bark and that will definitely affect its yield capacity. In general we are moving away from recommendation of ladder tapping; when it is used we feel that a third daily double-cut system should be employed to reduce the frequency of tapping and so give the high panel more time for bark renewal.

MR BARTLAM. Is there any information on yield obtained from renewed bark on ladder tapping?

MR DE JONGE. I have no experimental results to quote, but can give my own observations. I have seen very good yields indeed from six-year-old renewed bark on ladder tapping.

MR J.G. ALLAN (Gadek Estate Ltd, (Kupang Division), Baling, Kedah). I have a system of tapping eight months high, eight months low, alternate daily. I would particularly like to know if anybody else in the Conference has any experience of this system. It has proved exceptionally useful in keeping my yield up.

MR DE JONGE. The great attraction of this system is that it could keep down brown bast incidence. You can tap the high panels at any time except during wintering which has an adverse effect on the yield of the high cut.

MR ALLAN. In practice, I have not found this effect of wintering, except in the case of clone Tjir 1.

Open Discussion. Weed Control and Herbicides

Introduced by Dr G.A. Watson, Head of the Soils Division, R.R.I.M.

DR WATSON. The ban on sodium arsenite is due to be introduced on September 1st. Negotiations are still going on between the Rubber Producers' Council and the Government on this matter, and no final decision has yet been taken.

The Institute and some commercial firms have been working on possible alternatives to sodium arsenite for some years, and you will find a general summary of our work on this subject in *Planters' Bulletin* 44, September 1959. The recommendations in that article still hold good, but since then we have investigated three other promising herbicides. The first is a mixture of sodium chlorate and aminotriazole. Sodium chlorate is a non-persistent contact herbicide but by mixing aminotriazole with it, in the ratio of about 25 lb of sodium chlorate to 4 lb of aminotriazole, a much more persistent effect is obtained. The second is Simazine. This is the pre-emergence type of herbicide which is sprayed on bare soil and prevents the germination of weed seeds. The manufacturers have been working on Simazine in Malaya for some time now and have definite recommendations on its use. It appears to have promise in oil palm plantations and in the maintenance of planting rows in rubber. It may also prove useful in the establishment of legume covers. Ir Reipma of the R.R.I.M. is now carrying out further work on this herbicide. A third chemical is Paraquat. This is a very effective contact herbicide, its effect taking place within one or two hours after application. Although it is non-persistent, it holds considerable promise. Paraquat is still not available in commercial quantities. (Dr Watson then showed a table showing the estimated costs of substitutes for sodium arsenite. All of them were more expensive than sodium arsenite).

MR D.M. GOLD (Dusun Durian Estate, Banting, Selangor). There must be a great deal of variation between the effects of different covers when uncontrolled and control policies must be governed by the relative harmfulness of the various covers. Which covers are likely to have the most harmful effects on rubber?

DR WATSON. Our cover plant experiments are well under way but it will be a few years before we can make firm recommendations. On inland soils, however, we can say fairly definitely that *Mikania scandens* depresses tree growth; this is consistently shown in our experiments. Surprisingly, the adverse effect of grasses on tree growth is less than we expected. Trees grown in association with legume covers are growing better than those with grass covers, but on certain soils, notably the heavy coastal clays, the difference is small. If I were a planter, I would not consider it economically worth-while to plant leguminous creepers on coastal clay soils. The general picture on our inland soils

is that the legumes are quite a long way the best, and *Mikania scandens* is the worst. No planter has any justification for deliberately planting *Mikania scandens* now. On grasses we shall have to reserve our opinion for some time, possibly three or four years. We have one recent recording from an experiment on coastal clay where tree growth (two years after cutting back) is actually better under grasses than under legumes. This is of course an isolated case, but it does prevent us from asserting dogmatically that legumes are superior to grasses on all soils. Grasses in the early stages of a planting may not do much harm, although they are certainly less beneficial to the soil than leguminous creepers, but it seems possible, from the beneficial effects on the tree foliage that are noted when grasses under mature rubber are sprayed out, that grasses will have an adverse effect on rubber from about the fourth year onwards. Sodium arsenite has so far been available to spray the grasses out at this stage, but in future more expensive herbicides will be needed, thus increasing the cost of control.

MR W.L. HARVEY (Sungei Wangi Group, Sitiawan, Perak). The effect of legumes is surely one of building up the fertility of the soil over a period of years? What, in Dr Watson's opinion, is the life of a legume cover under young rubber?

DR WATSON. Three to four years.

MR HARVEY. I would say seven years.

DR WATSON. I would hesitate to say that is possible on all plantings of rubber.

MR HARVEY. I manage a coastal clay estate and I keep the covers in for seven years under buddings and five to six years under clonal seedlings by controlling the pests of the covers. Surely Dr Watson is not going to say that grass is preferable on any coastal clay? Grasses have a notoriously bad effect on mature rubber. After legumes you get *Nephrolepis* coming in, which is probably the best cover for mature rubber, particularly on coastal clay.

DR WATSON. Yes, I quite agree; I made the point that grasses in mature rubber had an adverse effect and that the trees benefited when the grasses were sprayed out. Is Sungei Wangi a true coastal clay? I believe you also have clay loams there.

MR HARVEY. Yes, the soil is poorer than at Telok Anson.

DR WATSON. The areas I referred to are the heavy coastal alluvial clays. Certainly I support your statement that the grasses do not have the beneficial effect on soil that legumes do, but in your coastal alluvial clays there is already a large reserve of plant nutrients and there is consequently very little need for legumes. If between \$300 and \$400 an acre are to be spent in establishing and maintaining leguminous covers for three to four years it will be much more difficult to justify the cost of those covers on alluvial clay than on inland soils.

MR S. SANDISON (14, Jalan Buloh Kasap, Segamat, Johore). I wonder if Dr Watson would tell us whether he considers that *Imperata cylindrica* is a grass or not.

Weed Control and Herbicides

DR WATSON. *Imperata cylindrica* is of course a grass which cannot be tolerated and there are other grasses in the same class, *Ischaemum muticum* for instance, which would rapidly swamp your rubber. The grasses you would tolerate, on certain fertile soils perhaps, are *Axonopus compressus* and *Paspalum conjugatum*. They also grow very vigorously, but they can be kept in check. I merely put this forward as a possibility, bearing in mind the cost of leguminous creepers. I said that I was surprised that up to about three years after planting, these grasses were coming a close second to our legume covers, judging by tree growth, whereas it has always been supposed that they would have a very adverse affect on the growth of young rubber.

MR J.E. BARTLAM (Sogomana Estate, Lumut, Perak). Surely the legumes will build up more fertility in the soil in the long run?

DR WATSON. I am very strongly in favour of legumes, but one must bear in mind the high cost of legume covers, and the fact that they may sometimes induce wind damage susceptibility in our vigorous modern clones. In addition, we are now discovering that grass covers are not seriously checking tree growth in the first three years. That is the experimental point of view. Certainly if I had an eroded lateritic soil I would plant pure legumes as covers despite the cost. On a heavy coastal alluvial clay (this is purely my personal opinion), I would not plant leguminous covers but would allow the better natural covers to come in, the chances being that in about three to four years there would be a good stand of *Nephrolepis*. On a very poor inland alluvial sand such as one finds in some of the ravine areas, I would not bother to put in legume covers. On such a poor soil, legumes are usually an expensive failure, whereas other plants might give better cover. However, our main topic was to have been sodium arsenite and its alternatives, not cover crops.

MR V.V. CHELLAM (Rubber Estates of Malaya Ltd, Kota Tinggi, Johore). Which theory does Dr Watson support — 'nothing is better than grass' or 'grasses are better than nothing'?

DR WATSON. At what stage do you mean, at the beginning of planting, at three to four years of age, or at maturity?

MR CHELLAM. From the beginning of planting onwards.

DR WATSON. Grass is infinitely better than nothing in the early years (say until the trees are four to six years old) and a thin scattering of grass will be better than nothing in hilly territory during maturity.

MR J.G. ALLAN (Gadek Estate Ltd, (Kupang Division), Baling, Kedah). We are finding in Kedah that a mixture of sodium chlorate and Fernoxone is very useful for strip spraying of the planting rows; 40 gallons of water, 7 lb of chlorate and $\frac{1}{2}$ lb of Fernoxone is working very well indeed in dry weather. We have a very mixed cover of *Pueraria*, *Mikania*, *Centrosema* and various creepers and grasses.

DR WATSON. The amount of sodium chlorate seems a little light, but Fernoxone is the most effective chemical for use against *Mikania* and creepers.

MR ALLAN. Several planters have tried this mixture and it has done very well. We find 7 lb of sodium chlorate sufficient.

MR D.G. EASTAUGH. (Effingham Estate, Kuala Lumpur). I wish to add something to your statement about Paraquat not killing rubber trees. The manufacturers have carried out spraying trials on my estate recently. When the Paraquat was sprayed on the bark of the trees there was no damage, but when it was sprayed on the leaves the trees died.

DR WATSON. Yes, I agree that the brown bark of a tree will tolerate this chemical, but other parts of the tree will not.

Open Discussion. Cover Plants, Manuring and Wind Damage

Introduced by Dr P.R. Wycherley, Botanical Division, R.R.I.M.

DR WYCHERLEY. Although bending and breaking of immature rubber does occur, our main concern is with trunk snap of trees which have been in tapping for some time, to which some clones are more prone, for example RRIM 501, 614 and LCB 1320. When we compare trees which snap with those which do not, whatever their previous history, we have to discover whether the load was too great or the trunk too weak (either because the timber itself was weak or because the trunk was not thick enough) or whether both factors operated. Remember that the total strength of the trunk is proportional to the cube of its thickness.

Mr Rosenquist has reported* that increasing applications of either nitrogen or phosphate led to heavier wind losses. In another trial he found that no manuring resulted in fewer trunk snap cases than application of NPKMg fertilisers with either a high or low nitrogen/potash ratio. We have tested the strength of timber specimens from a manurial trial on RRIM 501 and found slight weaknesses associated with high phosphate and high potash applications. Leaf analysis showed the weakness to be associated with high calcium and high potash content. Thus in our trial, timber strength itself shows no weakness resulting from nitrogen applications. There is nevertheless considerable circumstantial evidence that severe bending and trunk snap incidence are associated with heavy nitrogen applications and the heavier foliage promoted by nitrogenous manuring may well be responsible.

What is the effect of cover crops, first on susceptibility to bending and breaking in immature areas and, secondly on proneness to trunk snap when the trees are in tapping?

In one trial comparing nine cover plant types, RRIM 603 was budded. It is still immature. RRIM 603 is notorious for bending and

* *Proceedings of the Natural Rubber Research Conference, Kuala Lumpur, 1960* (Published 1961 by the R.R.I.M.)

the obviously heavy crowns in the creeping legume plots caused anxiety; some leaning had begun. Corrective pruning was carried out throughout the trial. An average of $7\frac{1}{2}\%$ of the trees were pruned in all plots, but 15% had to be pruned in the creeping legume plots. Shortly afterwards more severe leaning and bending occurred and a count was made of trees requiring roping or pruning. If the trees pruned or roped etc. at any stage are added together, i.e. all those treated in any way, the average is about 16%; the range is from 13% for *Flemingia* to 21% for *Mikania*, with creeping legumes at 19%. On the whole we encountered most difficulty in the creeping legume plots where the trees had heavy crowns and in the *Mikania* and *Eupatorium* plots where there were thin stems. Incidentally all trees received equal manuring at a lower rate than usually recommended. Possibly legumes with no fertiliser or *Mikania* with more fertiliser might have had better effects.

Turning to the after-effects of covers, it has been suggested that the presumably steady release of nitrogen from legumes will lead to more even growth and therefore greater timber strength than will intermittent applications of nitrogenous fertilisers. This suggestion seems unlikely to be substantiated since nitrogen does not appear to affect timber strength. On the other hand, applications of phosphatic fertilisers (containing phosphate and calcium) to the covers might possibly reduce timber strength to a slight extent. Mr Rosenquist found that high phosphate increased wind damage losses.

We know of plantings on fertile coastal clay, which have received no fertilisers except in the planting hole, where trunk snap of RRIM 501 has occurred after some years of tapping. We believe legumes were sown in these areas but in general they did not persist well. This only shows that the absence of intermittent fertiliser applications does not ensure freedom from wind damage.

There are differences in timber strength especially between clones, but these are not consistently related to their known wind damage susceptibility. We must still pay attention to timber strength, but only as one of several factors among which girth, weight and distribution of the canopy often seem to be more important.

When one tries to explain the differences in wind damage incidence between pre-war and post-war plantings, one must first remember that there has always been considerable variation in the ground covers employed. Secondly, there are many other differences, not only in manurial practice, but in choice of planting material and girth at opening, which are probably more important.

Summing up, the main factor involved in either bending during immaturity or trunk snap under exploitation appears to be imbalance in the relationship between crown and trunk size. The tree needs a certain minimum amount of canopy to grow and there is probably an optimum relationship between canopy and trunk size for maintained

growth and hence improved support. If sudden flushes of heavy foliage were induced by very large nitrogen applications, there would be a risk of at least temporary imbalance until girdling 'caught up' with crown development. The balance may not be restored in some mature trees which divert a large proportion of their assimilates into crop. Therefore when manuring susceptible material, consider either reducing the amount of nitrogen given or applying smaller doses more often. The best and most economic method in practice has not yet been worked out. On this point the way in which legumes return nitrogen to the soil is important. Dr Watson has a slide to show you illustrating this point. (Dr Watson then showed a table illustrating how legumes return far more nitrogen to the soil than do *Mikania* or grasses. Very large quantities of nitrogen are returned during the period when the commonly used creeping legumes are being shaded out by the trees. Reduction in fertiliser applications at the time of shading out is therefore recommended).

COMMANDER J.D. MOSS (Jalan Acob Estate, Kapar, Selangor). I find it possible to prune any clone correctively from the start and so prevent leaning. RRIM 603 has been quoted as a bad leaner. My RRIM 603 trees budded 3-4 years ago, all pruned at an early stage, show no signs of leaning. One must keep the branches evenly distributed around the tree from the beginning. Finally, I also have RRIM 501 planted in 1947. I have not lost a single tree, but we have done corrective pruning the whole time.

DR WYCHERLEY. As we pointed out in an article in *Planters Bulletin* two years ago, growers of tree fruit and tea are always rather surprised to find how little pruning and juvenile care rubber planters give to their plants.

MR CHEN JAN JEE (Lee Plantations Ltd, Singapore). I have 450 acres of RRIM 603 cut back three and a half years ago. Not one single tree has bent but I have not done any pruning at all! The area was planted 20 x 10 ft to give rapid shade (as we were unable to plant covers for special reasons), strip sprayed several times and regularly manured. There was no pruning other than up to 12 ft.

MR S. SANDISON (14, Jalan Buloh Kasap, Segamat, Johore). In the south of Johore you do not get wind breakage even in clone Tjir 1, because of the climatic conditions. That is why Mr Chen has no trouble with breakage of RRIM 501 or bending in RRIM 603.

DR WATSON (R.R.I.M.). Mr de Jonge mentioned this morning a case of some RRIM 501 that did not break purely because it was stunted. The soils of south Johore are not in general as good as those in the rest of the country. If the trees are shorter and do not develop a heavy canopy, they will not be so susceptible, and so one should consider the soil as well as the climatic factor.

MR D.J. GAWTHORN (Bukit Asahan Estate, Asahan, Malacca). On the question of soil in relation to RRIM 501, I have one block of 70

Cover Plants, Manuring and Wind Damage

acres of this clone on Malacca series soil completely ruined while another block on the much poorer Batu Anam series is equally well grown but with no damage at all. The girth measurements are roughly comparable, but I have no height measurements.

MR C.B. LEA (Harpenden Estate, Kapar, Selangor). Our RRIM 501 grows very high and becomes unbalanced. In order to improve the balance, we tried nicking above the buds from about 14 ft up the trunk when the trees were about 8 in. girth. This was done two years ago. Several of the buds have produced branches and they appear to be giving quite a well balanced effect. Trees planted 20×14 ft have a more balanced appearance than others planted 30×8 ft.

DR WYCHERLEY. We need far more information on the relation between wind damage and planting distances, exposure to wind, soil type and all the other factors. On this point we should welcome more help from planters who could report on what has happened and also what has not happened over far wider areas than we can cover in our experiments. We have made some observations on wind damage in material planted at different distances. It is our impression the more nearly the planting system approximates to 'square', the more balanced is the crown development — not only on RRIM 501 but also on other material. Of course 'square planting' is costly in weeding and in preparation of terraces and is infrequently used.

MR J.B. HENDRIE (Ulu Tiram Estate, Johore Bahru, Johore). I would like to report cases of two estates where hills and undulating land were planted with Tjir 1 clonal material. The hills were planted on the contour, but not the undulating land. The wind damage on the undulating area was very much more severe than in the contoured area. This would imply that planting on the contour, even on gently undulating land, would tend to prevent a certain amount of wind damage. With regard to Mr Rosenquist's observations on the relationship between nutrient content of the leaves and wind damage would it not be possible to have leaf analyses done on all the seriously wind damaged areas?

DR WYCHERLEY. For all such purposes we like to compare wind prone and wind fast material, but insufficient reporting of wind fast areas of reputedly susceptible material (especially RRIM 501) makes it difficult to plan such comparisons.

MR J.G. ALLAN (Gadek Estate Ltd, (Kupang Division), Baling, Kedah). Could you not conduct a 'Gallup poll'?

DR WYCHERLEY. We have sent out various circulars requesting information, but often the number returned is disappointing.

MR BOON WENG SIEW (Malaka Pinda Estate, Alor Gajah, Malacca). Mr Rosenquist suggested manuring with high potash fertilisers to prevent wind damage. Mr Chen Jan Jee's RRIM 501 at Sungei Plentong Estate is on sandy loam. Is it correct to assume that sandy soils contain less potash and in that case does potash really help in preventing wind damage?

DR WATSON. Work that we have done on wood strength and nutrient content did not confirm Mr Rosenquist's work. They seemed to indicate that high potash content led to weak wood strength, but the effects were not large. The soil at Sungei Plentong Estate is a coarse sandy clay loam, needing potash but not at high levels. They are not the same as the alluvial sandy soils which are very definitely deficient in potash.

DR WYCHERLEY. In Mr Rosenquist's Natural Rubber Research Conference paper the effects of potash were inferred from leaf analysis in the first experiment which was concerned with nitrogen and phosphate manuring only. N:K ratios showed some correlation with losses in the N series but not in the P series. In the second experiment on wind susceptible RRIM 501, the treatments included no manuring (19% losses of trees), a conventional high N:K ratio fertiliser (38% losses) and a special low N:K ratio mixture (30% losses). Thus reducing the N:K ratio did help, but not so much as omitting manuring entirely.

Open Discussion. Root Disease Control

Introduced by Dr A. Newsam, Head of the Pathological Division

DR NEWSAM. In old rubber there is little scope for innovation in root disease control measures. Where there is a fair expectation of yield, disease patches can be isolated by trenching; otherwise the disease must be left to run its course. There is most scope in young rubber, and the most danger of a serious situation arising if control measures are neglected—as by leaving stumps unpoisoned or letting covers grow round the trees. Recently we have made a start on studying root disease and its control in new planting, but most of our efforts over recent years have been concentrated on replanting. As a result, a radical change has been made in our recommendations for root disease control. Whereas, before the war, the emphasis was on tracing and eradicating the sources of infection whenever root disease appeared, we now advise as far as possible leaving infected material to rot away, meanwhile making sure that the diseases do not become established on the young stand. On the face of it this policy appears to be hazardous, yet it is proving successful.

It would be a valuable adjunct to the control procedures now advocated to be able to apply, to the collars of trees that have been opened up for inspection, a dressing that would give lasting protection to the tree. We have had some success in preliminary tests with such materials, in the form of fungicides in a grease, petrolatum or drying oil base.

We have come to realise the part played by spores in spreading infection, by way of colonising moribund wood which then infects the rubber trees by vegetative spread. In consequence, we stress the importance of poisoning any rubber stump that is left in the ground, and

Root Disease Control

of treating the cut surface with a wood preservative to hinder spore colonisation. For very many years no such precautions were taken. We are inclined to attribute to this fact the present extent of the root disease problem on Malayan rubber estates.

Now that the situation is better understood, it should be possible very largely to prevent the establishment of new centres of infection (by spore colonisation) and to eliminate existing centres. In other words, the eradication of root disease as we have always known it should eventually be feasible. This may not, however, be the end of all root infection troubles, for we have recently suspected the occurrence of minor root rots destroying the small lateral roots of young plants, and so causing stunting of growth. Our investigations of this are at an early stage, however.

MR W.L. HARVEY (Sungei Wangi Group, Sitiawan, Perak). I would like to ask Dr Newsam whether he is really convinced that foliage identification of root disease in young rubber is sufficient to bring a young stand to maturity without the loss of patches of trees. We believe, as the result of experience with many thousands of acres, that it is necessary to look for the disease around the roots. Foliage identification will be too late to prevent the spread of the disease from the first diseased tree to its neighbour.

DR NEWSAM. I agree that there is some loss of neighbouring trees where foliage identification is used. Nevertheless, when we have compared foliage inspection with collar inspection as a routine, lower *total* losses have followed foliage inspection. There is some room for compromise between the two; indeed, in our published advice we advocate collar inspection of trees adjacent to those found infected and repeating this inspection during routine rounds of foliage inspection for the succeeding year. Further, we advocate a sample collar inspection, to be extended if found necessary, before the final stand is selected.

MR K.V. VEHMENDAHL (Changkat Asa Estate, Tanjong Malim, Perak). We have been treating root disease with Tillex and I would like to hear your opinion of this treatment. We find that in 50% of the treated cases complete reinfection occurs after three to four weeks.

MR R.A. FOX (R.R.I.M.). Tillex has been recommended for both prophylactic and curative treatment and before stating an opinion I think it will help if I give you a brief history of the subject. (Mr Fox then showed a series of slides). The first publication which recommended Tillex presented illustrations of Petri dish tests purporting to show that Tillex was much more effective than other fungicides in inhibiting the growth of *Fomes lignosus*. Circles of filter paper soaked in the respective fungicides had been placed on opposite sides of the dish of aqueous jelly, at the centre of which was a culture of the fungus. Such a test has a clear bias in favour of a water soluble material such as Tillex which is able to diffuse into the jelly and so inhibit the fungus, whereas an insoluble material such as sulphur shows no effect until the

fungus reaches the disc of filter paper. Further, in any test, relative costs of the fungicides must also be considered when evaluating effective concentrations.

To be effective as a prophylactic the fungicide must be persistent in the soil. The persistency of 2% Tillex in peat and sandy loam soils, following its use as a drench, has been assessed by measurements of the growth rate of *F. lignosus* in specially prepared tubes. In peat there was an initial inhibiting effect, but after six weeks the fungus was growing faster than it had before treatment. In sandy loam the inhibiting effect was even more short-lived. Such a non-selective poison, by drastically upsetting the soil microbial balance and subsequently being degraded or leached away, may actually encourage the growth of root disease fungi if these colonise the soil before the microbial balance is restored. We have observed this phenomenon in inoculation experiments where collars of trees were treated with fungicidal drenches, including Tillex, which were being tested for their potential prophylactic value.

The most important part of the treatment of infected trees is severing the fungus from its food base. When this has been done the superficial rhizomorphs are innocuous and the application of a fungicide to them is unnecessary.

DR NEWSAM. Experiments by Mr K.P. John emphasise the harmless nature of rhizomorphs of *F. lignosus* when separated from their food base. After the infected roots of young (4½- to 6-year-old) trees were severed and the sources of infection removed, four treatments were given: removing rhizomorphs and applying a fungicide, as in the old recommendations; removing the rhizomorphs but not using a fungicide; leaving the rhizomorphs and applying a fungicide; finally, no further treatment. There was 100% recovery of the trees following all four treatments.

MR V.V. CHELLAM (Rubber Estates of Malaya Ltd, Kota Tinggi, Johore). I want to speak of my experience of Tillex, in a four-acre area where we suspected *Fomes lignosus*. Stumped buddings were planted after the recommended prophylactic treatment using 5% Tillex solution which was allowed to dry on the roots. We then poured one gallon of a 1% solution into each planting hole. At the end of four months we had lost about 70% of the trees.

MR R.D. STONEHEWER (Sedgeley Estate, Kajang, Selangor). Is anything known about the effect of the physical condition of the soil (especially soil structure) on the incidence of *F. lignosus*? From my observations there is a quicker spread of infection in soils which are damp and rich in humus. The infection rate is greater, but the number of infected cases is the same. In poorer soils, and also in clay soils, *F. lignosus* seems to travel more slowly.

DR NEWSAM. We have conducted no experiments on this. Certainly the distribution of the root diseases is quite uneven, but we do know

Root Disease Control

that *F. lignosus* occurs most frequently in the damper parts of the soil, as in ravines. The subject is one that we plan to investigate more fully in the course of a survey of the root disease situation on plantations. From this survey a general picture of the relationship of root disease to soil conditions may emerge.

MR STONEHEWER. May drainage be a factor — improved drainage slowing down the rate of infection?

DR NEWSAM. In some soils I imagine that it would, but the control of root disease is not really a difficult operation; the correct type of drainage must surely be determined by other considerations.

MR C. ROBINSON (Rinching Estate, Semenyih, Selangor). I would like to return to the subject of Tillex. The diagrams shown by Mr Fox were very interesting, but was there continuity of treatment? Tillex must be applied regularly. There have to be at least three successive monthly treatments with Tillex, followed by inspection and further treatment if necessary. Some years ago Mr Hilton saw our estate and I think he agreed that Tillex was ineffective against *Ganoderma* but might depress *Fomes* to a certain extent.

MR R.N. HILTON (R.R.I.M.). When I saw the treated area I raised the question of the extent to which the sources of infection were being removed. If the sources of infection were removed, recovery would be quite unrelated to a fungicidal treatment.

DR NEWSAM. In our tests Tillex was applied once and it persisted in the soil for three or four weeks only. The economic aspect must be considered. An effective soil fungicide would have to be cheap and persistent. Even one application of Tillex is quite expensive.

MR ROBINSON. I wonder if it would be worthwhile for the R.R.I.M. to set up an experiment with a certain amount of continuity of treatment. I agree that the economic aspect must be considered, but on the other hand root disease is widespread and we have to stop it. Such an experiment would enable us to decide on the value of Tillex.

DR NEWSAM. I do not consider the claims made for this material to be based on convincing evidence and therefore do not believe a field experiment on an estate scale would be justified, when laboratory and small scale field tests give no indication that the material would be useful.

MR STONEHEWER. Years before the war one method of root disease treatment was to excise any diseased roots and leave the healthy roots exposed.

DR NEWSAM. This procedure can halt the infection but it is unsatisfactory because the anchorage of the tree is weakened.

MR J.B. HENDRIE (Ulu Tiram Estate, Johore Bahru, Johore). Anyone who has a surplus of Tillex may like to try mixing a 2% solution with Flintkote to give a 50/50 mixture, which appears to have a greater persistence. However, I am not an advocate of Tillex.

(Dr Newsam then presented some interim figures from current experiments in replantings bearing on methods of detecting and treating

root disease, and of dealing with sources of infection. Routine tree-to-tree collar inspection had given not only higher incidence figures but also higher losses than foliage inspection. No treatment whatever had given by far the lowest losses in the early years, but the disease was becoming established and an increasing rate of loss had to be expected in the absence of control measures. The Pathological Division was seeking to find the minimum treatment that would prevent the disease from becoming established on the young stand, and some experimental evidence was presented in support of limiting treatment to the planting row. Further, there were indications that, with *F. lignosus* at least, disease sources in the old stand prior to replanting did not need to be eradicated provided that all living stumps were poisoned and given a surface treatment with a fungicide.)

MR I.T. STEVENSON, (Sungei Chinoh Estate, Trolak, Perak). Is an experiment being done to find the effect on root disease of light cultivation prior to replanting?

DR NEWSAM. We have not carried out exactly the experiment suggested, but we have one at Sungei Buloh comparing mechanical clean clearing (using light tractors) with felling and stump poisoning, and another on an estate where mechanical clearing by heavy equipment is being compared with tree poisoning or felling and stump poisoning. The results are not available yet.

Proceedings of the Natural Rubber Research Conference, Kuala Lumpur, 1960

ORDERS MAY BE PLACED for the printed Proceedings of this Conference, published by the Rubber Research Institute of Malaya in March 1961.

AT THIS INTERNATIONAL CONFERENCE, attended by 300 delegates from the various natural rubber producing and consuming countries, 80 scientific and technical papers were presented on the production, preparation and use of natural rubber.

THE PRINTED PROCEEDINGS, consisting entirely of original papers, present the latest information on current research in the natural rubber field and will be an important source of reference for many years to come.

BOUND IN REXINE IN A SINGLE VOLUME, the Proceedings contain over 1000 pages, including the lectures by the guest speakers, Professors Blackman, Bonner and Gee, the final summary by Sir Geoffrey Clay, all the technical papers (fully illustrated) presented at the Conference, together with discussions, and a list of participants. The volume consists of three main parts: 'General Sessions', 'Natural Rubber Production' and 'Preparation and Use of Natural Rubber and Latex'.

THE PROCEEDINGS ARE ON SALE at \$23 (Malayan) per copy, approximately equivalent to \$7.50 U.S., 37 Francs or £2-13-8. In addition the cost of postage and special packing is:

within Malaya \$1 (Malayan)

outside Malaya \$2 (Malayan) book post or \$5 parcel post

IF YOU WISH TO ORDER copies of the Proceedings, kindly send your order, together with your remittance, to the Director, The Rubber Research Institute of Malaya, P.O. Box 150, Kuala Lumpur, Malaya.

OUR COVER PHOTOGRAPH SHOWS A
TAPPER AT WORK AT THE R.R.I. EX-
PERIMENT STATION, SUNGEI BULOH.

Photo C.T.Y.

